The UNESCO Courier

A window open on the world

June 1970 (23rd year)

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MAN IN QUEST OF WATER

XUM

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TREASURES
OF
WORLD ART

45

'Choker' for a Celtic princess

(Fed. Rep. of Germany)

Celtic culture flourished in Europe and attained the zenith of its artistic achievements during the "La Tène" period (5th century B.C. to 50 B.C.). The "La Tène" culture takes its name from the now famous archaeological site at the eastern end of Lake Neuchâtel, in Switzerland. "La Tène" period sites have been excavated in many parts of Europe. From one, a Celtic tomb discovered at Reinheim (Fed. Rep. of Germany) in 1954, came jewellery of rare beauty dating from the 4th century B.C. One outstanding find was a torque, or ornamental open collar, of solid gold (right) fashioned for a Celtic noblewoman, possibly a princess. Above, greatly enlarged detail of one of the twin decorative motifs at the open ends of the collar reveals the masterly handiwork of a Celtic craftsman.

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This issue of the UNESCO COURIER is published with some delay because of a strike at our Paris printers.

Cover

The Touaregs, the "people of the veil" who roam the Sahara, depend for their existence upon oases and waterholes scattered across the desert. Yet below the sandy wastes lies a vast underground reservoir extending over a quarter of a million square miles. In co-operation with the governments of Algeria and Tunisia, Unesco is surveying the underground water resources of the northern Sahara (see pages 9 and 10). Water has become a world problem of crucial importance for everyone. Within the framework of the International Hydrological Decade sponsored by Unesco, the community of nations is now facing the water problem on a scale never before attempted (see page 4).

Photo Unesco - Dominique Lajoux

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Man's perpetual quest for water

by Raymond L. Nace

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We are now at mid-point in the International Hydrological Decade, sponsored by Unesco. Since January 1, 1965 this vast programme has mobilized hydrologists the world over for man's first concerted attempt to take stock of his diminishing fresh water resources and to co-ordinate world-wide research on better ways of making use of them. Here, Dr. Raymond L. Nace, the noted American hydrologist, examines the historical and scientific background of the problem, and describes some major areas where this international co-operation has been in action.

SINCE the dawn of civilization, population growth and the expansion of human activities have depended on man's ability to surmount the natural restrictions of his environment, including the amount and distribution of water.

Water development and water policies always have been important, as is evident from the many measures taken to control its distribution and use, beginning with the ancient Sumerians of Mesopotamia and becoming ever more complex with the passage of time.

Even so, water problems are becoming increasingly critical in many regions, including areas in developed countries where water is relatively abundant. The reason is that in many regions problems are less apt to relate to water quantity than to its quality.

Broadly stated, water problems are few but basic: distribution in space (too much or too little); distribution in time (too much in some seasons or years and not enough in others); chemical quality (too highly mineralized; lacking in desirable minerals; containing deleterious minerals); and pollution.

Well-intentioned individuals speak confidently of surmounting all problems by achieving mastery of the environment. This is an illusory goal. Man first must master himself. The plain fact is that he has not done so, and because of this he has so completely upset the natural environmental system in which he evolved, that he no longer knows what his place is in the system except as an element of disorder.

We do know that water has a vital role in every earth environment from the depths of the sea to the highest mountain; from the driest desert to the wettest rain forest; and from the tropics to the polar ice-caps. It also has a role in every activity of man and beast.

Thus far, our attempts at "mastery of the environment" have been mere short-sighted tinkerings with the landscape. Meanwhile, other human activity has brought on unwanted, unforeseen, and poorly understood side effects.

Human activity already has contaminated the entire world ocean, the atmosphere, and even the remote ice caps of Greenland and Antarctica.

Most rivers are polluted to some extent and many are nauseous open sewers. Plant cover and soil fertility of vast areas have been destroyed.

Parts of the story of human despoliation of the earth have been told

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Even in countries where rainfall is abundant there may be a lack of the right kind of water where it is most needed, especially in the large cities of the world. To overcome this problem river water is re-cycled and re-used many times. Thus, before being returned to the rivers, water from the sewers of large towns goes through a treatment process. It passes through aeration tanks which supply the oxygen needed by the micro-organisms that break down and destroy harmful organic matter. Here, at a sewage treatment plant in the Paris area, treated water is piped into the Seine. It will probably be extracted, purified and used again several times before finding its way to the sea.

Photo © Bruno Barbey - Magnum

RAYMOND L. NACE, *former chairman of the U.S. National Committee for the International Hydrological Decade, has served as U.S. representative on the Co-ordinating Council of the Decade. Dr Nace is research hydrologist with the Water Resources Division of the U.S. Geological Survey, and in the U.S.A. has worked on problems of general hydrology and on the disposal of radioactive waste.*

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Conflicting theories on the last days of Mohenjo-Daro

many times. But the whole story cannot be told because not all of it is known and the story has not yet ended.

The problem is not mastery of the environment. The problem is whether nature can be preserved in some semblance of order and whether civilization can survive its own impact on nature.

The facts of history vis-à-vis the plight of most of mankind today are sufficient evidence that the problems of man and his environment are not problems of the men of individual nations. They are problems of all men and all nations.

This is especially true of water. The mobility of water is one of its most useful properties, but it also gives rise to serious problems, both practical and scientific, international as well as national.

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IRRIGATION IN ANTIQUITY. Over the past 7,000 years men at some time and place have been trying to increase the supply of fresh water, or at least to increase the share used before its inevitable return to the sea.

Ancient man, like modern man, evidently loved sunshine and dry warm weather. But in order to prosper and multiply in dry areas, a change was needed more profound than the transition from nomadic hunting and herding to sedentary farming. Crop farming without irrigation is precarious to impossible in dry areas.

Extensive irrigation, however, requires community effort for water diversion, maintenance of works, and allocation of water, and these can be achieved only through effective social and political organization. Civilization may have been a result of man's unwillingness to accept the limitations of geography and his search for means to circumvent these limitations.

Following the ice age, climatic conditions identical in all essential aspects with those that prevail now were established at least 5,000 years ago and perhaps 8,000. The Near East and Middle East already were arid to semi-arid, and it was there that the early civilizations arose. This was no mere coincidence, for the reason noted above. Climate determined the locale for the rise of civilization.

Looking at the long history of water management, it is surprising that the water cycle has been a mystery to man during most of his history. Sumerian knowledge about hydrology is problematical. Writers of their cuneiform inscriptions were concerned with military exploits and practical matters, rather than with intellectual adventures.

The people, however must have had extensive practical understanding of running water, else they could not have operated a large and complicated irrigation system on the Mesopotamian plain. They had such a system at least as early as 4 000 B.C., and perhaps much earlier. They and their successors held sway over a region of about 20,000 square kilometres, and much of this was irrigated, though not all at the same time. The Sumerian irrigation system was a marvel, not only because of its size but also because of its long existence.

Salinity and siltation plagued the irrigated fields in varying degrees from very early times, but the Sumerians learned to some extent to cope with the problems. So did their Semitic successors, and irrigation continued until the middle of the twelfth century. Hulagu Khan's invasion in the thirteenth century has been blamed for devastating Mesopotamia, but the area had been essentially abandoned a hundred years earlier.

Judging from experience with modern irrigation methods, it is doubtful that any modern system will last for a length of time even approaching that of Mesopotamia. In the vast and fertile Indus Plain of West Pakistan live more than 30 million people. An enormous irrigation network supplies about 9 million hectares of land (90,000 square kilometres). More than 2 million hectares already have been lost by salinity and waterlogging, and current annual losses are about 40,000 hectares.

The Indus Plain is only one example of irrigation problems. Dry areas naturally tend to have salty soil and ground water because not enough water moves through the local water cycle to flush salts away. Successful irrigation requires application of sufficient water for flushing and sufficient movement of ground water or drainage water to actually remove the salts from the irrigated area. Where drainage is inadequate, waterlogging aggravates the problem. Many tens of thousands of hectares annually are lost to production by salinity and waterlogging, principally in Asia, Africa and North America.

Organized large scale irrigation agriculture arose in the Nile Valley around 3400 B.C., following an antecedent period of small scale local developments. For a variety of reasons, the problem of irrigation there was far simpler than in Mesopotamia. Simple flood-basin irrigation practice was followed, first on the left bank only. Later, when basining spread to the right bank also, constriction of the river by both banks raised serious problems during high floods.

During the twelfth Dynasty a brilliant plan evolved to mitigate this problem—the Fayum project. This project used the Fayum depression as an off-stream reservoir into which excess waters were diverted, forming Lake Moeris in the desert 50 miles south-west of Cairo. During years of deficient flood water, stored lake water was led back to the valley.

The Egyptian irrigation system was unique. The irrigation basins were lavishly flooded, but only once each year. Sand and gravel beneath the valley soil provided good subsurface drainage. There was no need for irrigation canals or drainage ditches, and no general problem arose of salinity or waterlogging of soils. The annual deposit of silt obviated the need for fertilizer. It will be interesting to observe the future of the Nile Valley with a modern irrigation system, including a large up-stream reservoir where much of the sediment will settle out of the impounded water.

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FLOOD PLAINS AND CITIES. Modern peoples are not the first to build cities on river flood plains. Mohenjo Daro and Harappa, the archaeologically famous cities of a civilization that flourished on the Indus Plain during 2500-1500 B.C., got into trouble because the people did not understand or could not cope with the interactions of land, water, vegetation and man in a flood-plain environment.

The civilization deteriorated during a long period before it finally disappeared. A common supposition has been that the Harappan culture was based on irrigation agriculture and that it was defeated by soil salinization. However, some authorities say that evidence is lacking of any irrigation structures in Harappan times.

A recent theory is that the Harappan towns were destroyed by repeated flooding. Massive masonry walls around Mahenjo-Daro failed to protect it and it was engulfed and filled with silt. The nature of these floods was unusual.

A flood plain is exactly what its name implies—a land form built by the river during flood flows. A river is in flood when it overtops the banks of its channel. Overtopping is a normal recurrent event with most rivers, and minor flooding occurs every two or three years. Higher floods are less frequent. Indus floods in Harappan times, however, seem to have been different in nature.

According to one interpretation, some unidentified geological event

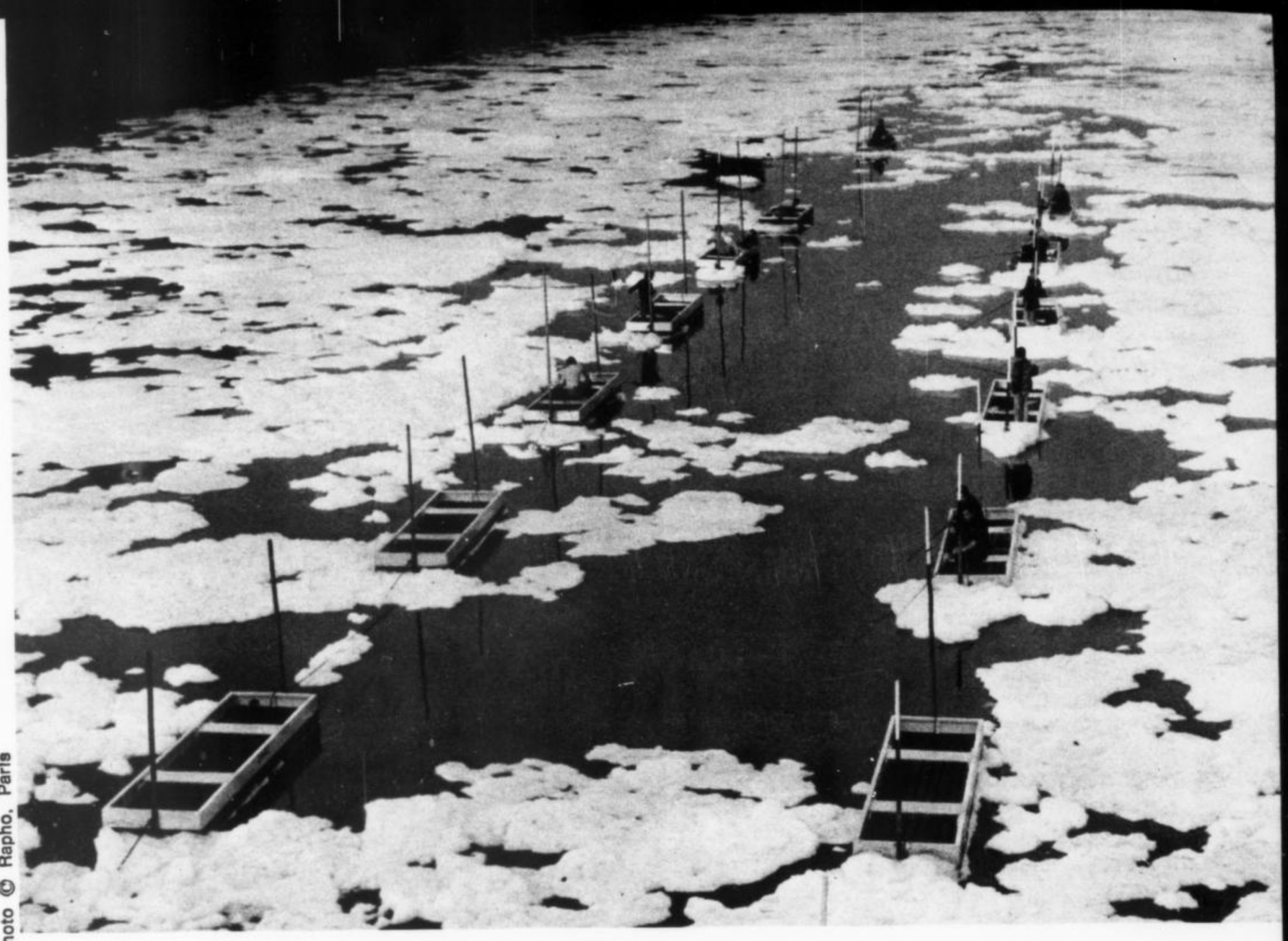

Photo © Rapho, Paris

Right, not floating pack-ice on a Canadian waterway, but detergent foam polluting a river in France. The products that make housewives' dishes sparkle are killing off insect and plant life of rivers in more and more countries. Insecticides and toxic chemical wastes from factories are destroying fish life.

interposed an obstruction on the Indus River down stream from Mohenjo-Daro, impounding a lake which engulfed the town with water and silt. After the lake's outlet eroded the obstruction and drained the lake, the people returned and built anew on top of the old masonry. This happened at least five times. A mound at the site contains artifacts to a depth of 22.6 metres, 7.3 of which are below the present water table and can be probed only by core drilling.

The evidence proves that the town was engulfed by silt and water, but whether by a lake or by flood water remains undetermined. The Indus Plain is very flat and a high flood would have many of the characteristics of a lake. At any rate, Mohenjo-Daro is an ancient example of a problem that has assumed major proportions in modern times.

Human encroachment on flood plains leads to ever-increasing damage to property and, in some cases, to loss of life. Modern man has not solved this problem either, because large floods cannot be controlled. They can only be combated.

Other ancient irrigation and public water works, as in Iran and China, are equally interesting, but the examples discussed illustrate that during many centuries before classical Grecian civilization arose, men had a great deal of practical understanding of water and how to manage it. They had invented the principal types of water control structures: diversion dams, storage dams, sluices, canals and drainage ditches; they used canals for irrigation, city water supply and navigation.

Their knowledge was largely or wholly empirical, but it was immensely useful. Ancient people learned also to tap sources of ground water and to promote groundwater recharge, but the degree of antiquity of this knowledge remains uncertain.

Ancient people also encountered the same problems that beset us today: maintenance of canals and drainage ditches; necessity for dredging and disposition of the spoil; public water supply; navigation; flood-fighting ; pollution.

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GREEK HYDROLOGY. Aside from practical problems of water control, the earliest coherent thinking about water as a substance and about the water cycle as a whole seems to have occurred in classical Greece. The Greek natural philosophers were intellectually methodical. They sought rational causes for effects, rather than invoking the caprices of gods as basic causes.

Although mythology strongly influenced their thinking, in principle they rejected myths, substituted rational deductions, and tried to reduce many facts to a few principles. Commonly they were wrong but, right or wrong, they were generally logical.

The first of the natural philosophers was Thales of Miletos (640?-546 B.C.). Knowing the ubiquity of water in the sea, on land, underground and in the air, Thales supposed that all substances originally came from water and eventually would revert to that form.

This may have been man's first attempt to reduce the bewildering diversity of matter to a common denominator. Thales believed that rivers are fed by the sea and that wind forces water into the earth. Once inside, the weight of overlying rocks forces the water upward into the mountains, from which it spills out to form rivers.

After Thales, the philosophers contributed little to ideas about water until the time of Anaxagoras of Clazomene (500-428 B.C.), a highly original thinker who rejected the Milesian idea of a primordial element. He believed that no transformations of matter could occur and that all substances had existed from eternity.

Anaxagoras formed a basically correct concept of the gross hydrological cycle: the sun raises water from the sea into the atmosphere, from which it falls as rain. Rain-water gathers in underground reservoirs from which the rivers flow. The earth generates no new water, but the reservoirs fill during the rainy season. Perennial streams flow from large reservoirs and ephemeral streams from small ones.

Democritus taught that the properties of substances depend on the shapes of their atoms. Water, for example, might be composed of smooth spheres, which would explain why it flows so readily.

Plato (428 or 427-348 B.C.) led a great advance in Greek thinking. He assumed that the universe was created by an organizing mind and that the universe, therefore, is understandable. The core of Plato's water cycle, however, was mythical Tartarus. He sup-

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PERPETUAL QUEST FOR WATER
(Continued)

posed that a series of interconnecting subterranean channels communicate with their source, the vast reservoir of Tartarus. Perpetual surging to and fro of waters in the subterranean reservoir causes the flow of springs and rivers. All water of rivers and seas returns eventually to Tartarus.

Aristotle of Stagira (384-322 B.C.), pupil of Plato and tutor to Alexander, the son of Philip of Macedonia, carried his thinking far beyond that of his mentor. His vast and omnivorous intellect ranged the entire scope of human knowledge and philosophy and, inevitably, included the water cycle.

Peremptorily, Aristotle rejected the ideas of Anaxagoras about the water cycle and Plato's Tartarus. He recognized that some springs are fed by meteoric water, but he believed that the main flow of water originates in great underground caverns where coldness transforms air into water. He differed with Anaxagoras also on the explanation of meteorological phenomena, such as hail storms.

Aristotle could not conceive that rain was any but a minor source of water for rivers and springs. He said that sea water turned into air under the heat of the sun, and that air turned back into water (condensed) in caverns under the influence of cold.

It happens that Anaxagoras came closer than Aristotle to explanations that are now generally accepted. Aristotle, however, marshalled more observational information than had Anaxagoras and some of these facts conflicted with the latter's beliefs. Aristotle's argument, therefore, was the more compelling and it was not successfully challenged for nearly 2,000 years.

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FROM IMPERIAL ROME TO THE RENAISSANCE. Before the Romans came under the intellectual influence of Greece they had learned much from the Etruscans, who were masters in the arts of irrigation and swamp drainage. This heritage enabled Rome to have a well-developed sewerage system as early as the sixth century B.C. Romans, in general, accepted the science of Greece and added little to basic concepts. Their great forte was engineering, as is evident from the aqueducts, bridges and other structures which still endure.

Roman engineers also invented delivery of domestic water through pipes to households. Curiously, they were quite unable to measure the flow of water in a conduit. They assumed that flow from a conduit depends only on the size of the orifice, ignoring the factor of hydraulic head.

During the Dark and Middle Ages many fanciful notions were current about the water cycle. One of these ideas, an elaborated inheritance from Greece, was that ocean water pours into submarine caverns which conduct it to the land areas, where it is distilled

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Photo © Georg Gerster - Rapho, Paris

Pancake Oases in the Desert

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Each of the "pancakes" in this striking aerial photo is a victory of man over the Sahara desert. The pancakes are tiny "oases" of palm trees made to grow by tapping zones of underground water in the Souf region of the northern Algerian Sahara. The village can be seen at centre right of photo. The palm saplings are planted in man-made hollows 20 to 40 feet deep (see detail next page) with palisades built to protect them from the driving sand. It is in this region of Algeria as well as in Tunisia that Unesco is now carrying out project "Regional 100" in co-operation with the governments of both countries and under the auspices of the U.N. Development Programme. "Regional 100" is a survey of underground water resources in the northern Sahara and a study of the best ways of exploiting such water for future farm development. South of the Sahara another major hydrological study is under way in the Chad Basin which constitutes a vast reservoir of underground water. Four countries—Cameroon, Chad, Niger and Nigeria—have formed a commission to plan the development of the Basin, an area of 400,000 square kilometres. Under a U.N. Development Programme project, Unesco, co-operating with the Chad Basin Commission, is making a general hydrological survey of the region, while FAO is studying problems of land reclamation.

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Photo © Georg Gerster - Rapho, Paris

PANCAKE OASES (Continued). **Photo left, close-up view of deep-hollow date-palm groves. Sand terracing, which can be clearly seen, prevents the trees from being engulfed by blowing sand. Photo centre, Lake Chad during the dry season. The outer periphery, seen here, has dwindled down into a series of shallow lagoons. Photo right, like giant mole hills running across the desert, these holes are shafts that mark the paths of foggaras, or underground tunnels, dug in ancient times for irrigation. This foggara, near In Salah, lies in the heart of Touareg country in the Algerian Sahara.**

and rises to the surface to feed springs and rivers. The medievalists were correct in that the sea is the source of water in the hydrological cycle, but they had the cycle turning in the wrong direction and they called upon the wrong distillation apparatus.

Such ideas persisted because men accepted the Greeks, especially Aristotle, as final authorities, and because of church dogma concerning a passage in *Ecclesiastes* which was interpreted to mean that continental waters originate by underground flow from the sea. To believe otherwise was heresy. Neither the natural philosophers nor the churchmen could accept precipitation as a sufficient source for water in the land areas.

Hydrology, like other sciences and the arts, was bound eventually to break with dogmatism and authoritarianism. The break came in a curious way. The French Huguenot, Bernard Palissy (1514?-1590), was a self-taught ceramist who created the naturalistic masterpieces of enamelled pottery which he called "rustiques figulines". His art saved his life. Arrested and sent to Bordeaux for trial concerning his activity in the new religion of the Reformation, he seemed to be doomed. But the Queen Mother, Catherine de Medici, intervened by naming him *inventeur des rustiques figulines du roi* (that is, of Henri III). As a member of the king's household he became immune to the parliament of Bordeaux.

Palissy boasted that he knew neither Latin nor Greek. He knew only what

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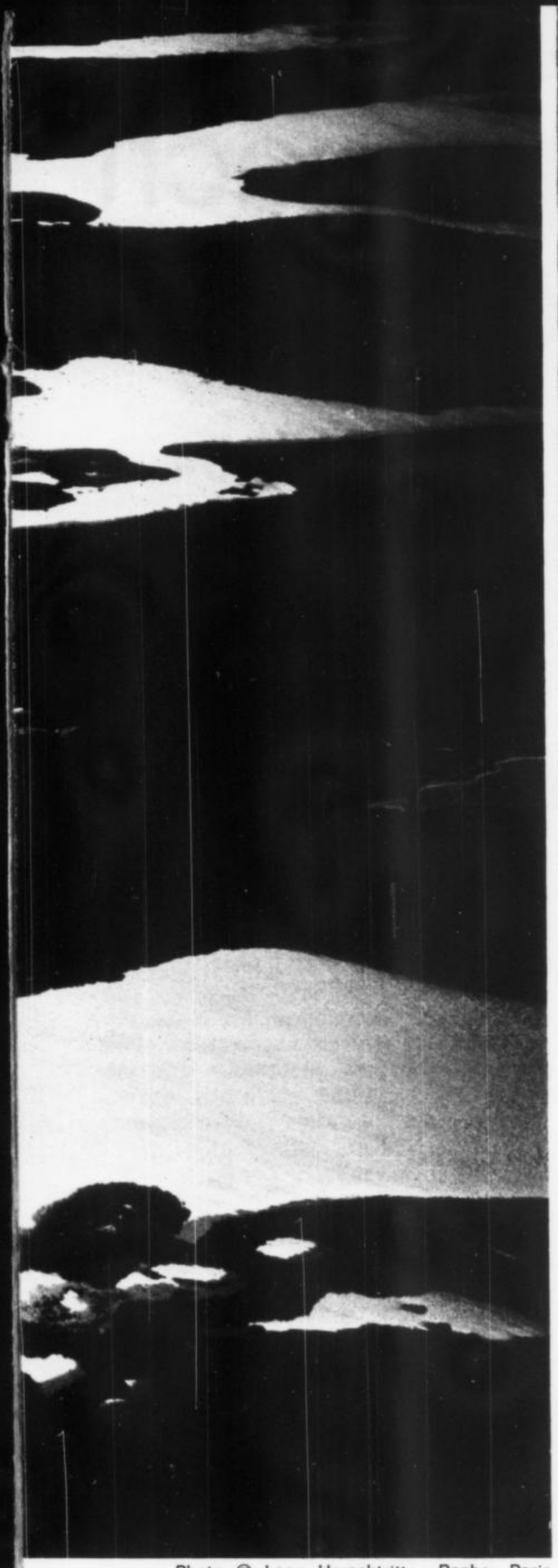

Photo © Leon Herschtritt - Rapho, Paris

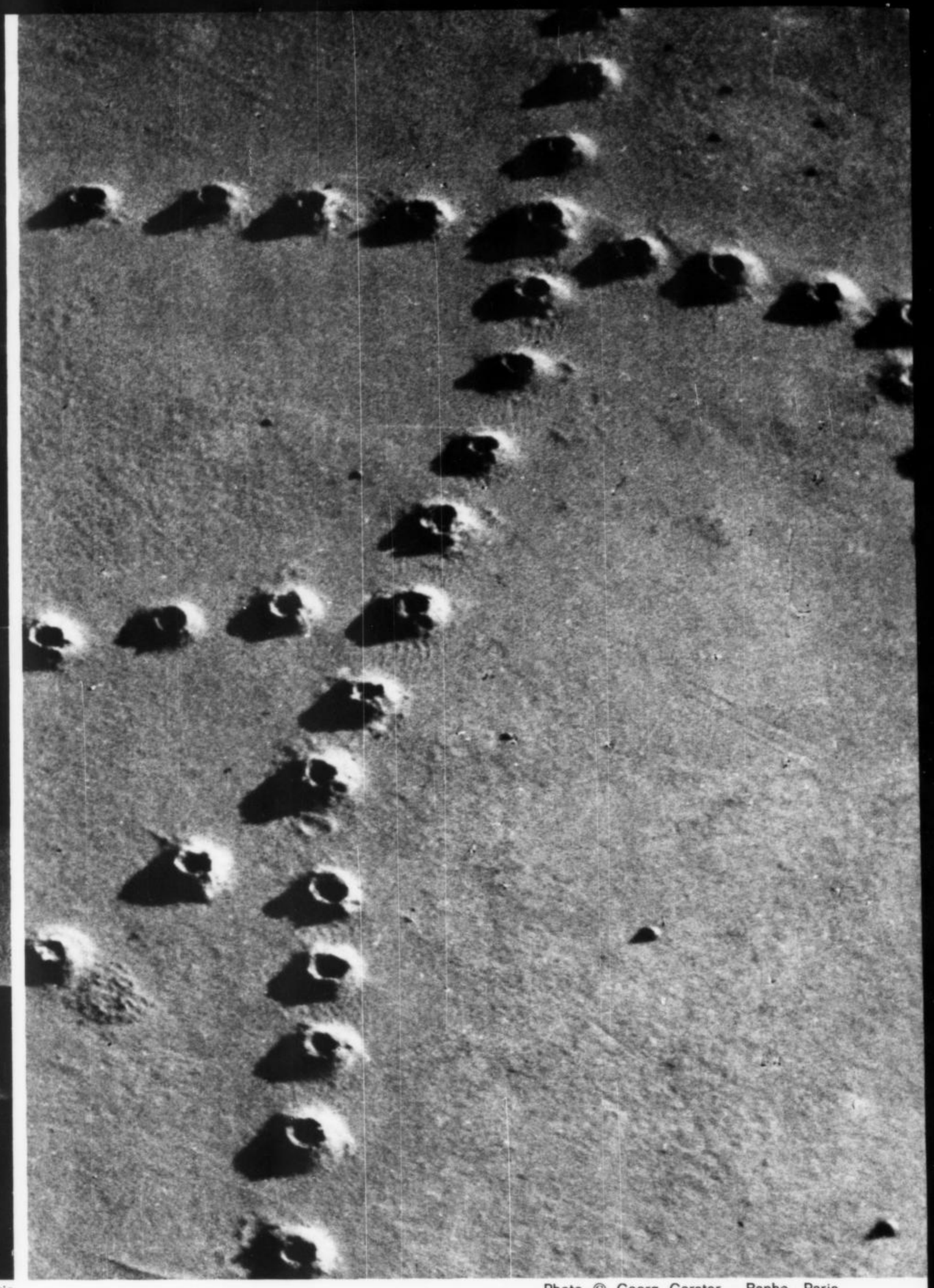

Photo © Georg Gerster - Rapho, Paris

he had seen during extensive travels as a surveyor before he took up ceramics. His observations were acute and, in the context of his times, he was an accomplished geologist, mineralogist and palaeontologist. Although Palissy rejected theory and relied on direct observation, he knew enough about authoritarian doctrine to be aware that it denied the adequacy of rain as a source for springs and rivers.

Nevertheless, what his geological eye saw convinced him otherwise. In a book published in 1580 he declared that springs and rivers take their origin in and are fed by rain and by rain alone. This may have been the first such declaration ever published. This was more important to mankind than the creation of his celebrated enamelled pottery, but Palissy received no scientific recognition in his own lifetime. The world waited nearly a century to awaken. Again, the catalyst was a Frenchman.

In 1668, the French amateur scientist, Pierre Perrault, convinced of the adequacy of rain as a source for runoff, set out to prove it. During three years he measured precipitation in the upper Seine basin, obtaining an average of about 49 centimetres annually. Calculation showed that this was about six times the estimated discharge of the Seine. He published this and other information in 1674.

Measurements and calculations such as these could have been made at any time during the previous 2,000 years, but science simply had not reached the stage of testing hypotheses by measurement and observation. Perrault it was, therefore, who initiated modern scientific hydrology. Perrault correctly accounted for the remainder of precipitation (the part that did not run off in the Seine), five-sixths of it being disposed of by groundwater recharge, evaporation, and transpiration by plants.

Perrault's findings were verified by others within a few years and hydrology was launched toward its modern course. The science is interdisciplinary, however, and could make no great progress along quantitative lines until the basic sciences of physics, chemistry and biology were well advanced, and until basic principles of geology were established.

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❷ A world approach to the water crisis

RIVERS of the world that reach the sea discharge about 30,000 cubic kilometres of water annually, and this is about 30 per cent of precipitation on the continents. However, only about 50 per cent of river discharge has been actually measured, the rest being estimated.

The Amazon, largest river in the world, had never been measured until 1963-64, when a joint Brazilian-United States expedition aboard a Brazilian navy corvette measured it three times, once at high-water stage, once at low-water stage, and again at an intermediate stage.

The average flow was found to be about 175,000 cubic metres per second, or about 5,540 cubic kilometres per year. This is roughly 18 per cent of the discharge of all rivers of the world.

According to these measurements, the Amazon is nearly twice as large as had been estimated earlier. These measurements alone upset earlier calculations of the world water budget and illustrate why large-scale measurements are important.

Water science is handicapped by unsatisfactory techniques and instruments for measuring many hydrological phenomena, especially on the very large and very small scales.

How, for example, does one measure the rate of movement of ground water through an aquifer underground? How does one measure evaporation from a whole continent or from the world ocean? These cannot be measured directly. They can only be estimated by measuring related phenomena from which computed values can be derived.

Evaporation and transpiration are important because they dissipate a large share of precipitation on land areas. Because of evaporation, man-made lakes are not unmixed blessings. In arid areas lakes may evaporate annually a layer of water equal to their surface area and up to three metres or more in thickness.

Evaporation plus transpiration are usually computed on the basis of solar radiation, wind speed, air humidity, temperature and other factors. Late in the seventeenth century, the British astronomer Edmund Halley, based on a brief experiment in his London quarters, estimated that annual evaporation from the warm Mediterranean sea was three feet (about 90 centimetres). The estimate was low and the modern estimate, averaged for the world ocean as a whole, is about 100 centimetres.

Measurement of precipitation has been practised systematically over an increasingly large part of the world during nearly two centuries. The first European meteorological network was established in 1780, with its easternmost station in Hungary. Europe and part of North America are now reasonably well covered, but precipitation on vast areas in Asia, Africa, South America, polar regions and the seas is virtually unknown.

The last ice age ended some 10,000 years ago, but much of the world is still locked in deep ice.

The great ice-caps of Greenland and Antarctica contain nearly 80 per cent of all water outside the oceans. Alpine, piedmont and valley glaciers are widespread; shelf-ice and pack-ice cover vast expanses of the polar seas; and permafrost (permanently frozen ground) occupies vast areas of Siberia, northern Europe and northern North America.

The total volume of ice-caps and glaciers in land areas is about 26 million cubic kilometres, while all other water in the continents amounts to only about eight million cubic kilometres.

Evidently, much of the world is still in an ice age, but relatively little is known about the frozen areas.

The great ice-caps seem to be stable, but considerable difference of opinion prevails about whether the ice masses are growing, shrinking or merely being maintained. It is important that this be determined because the ice areas are great weather factories and their melting would cause a rise of sea level.

The total land area of the world is 149 million square kilometres. About 15 million square kilometres is under permanent ice cover. Another 22 million square kilometres is in permafrost, comprising 22 per cent of all the land area in the Northern Hemisphere.

Nearly 40 million square kilometres is extremely arid to arid. Considerable areas are high-altitude mountain masses.

In all, more than half the world's land area is basically inhospitable for human occupation. Despite man's great adaptability, he has made relatively little encroachment in the inhospitable areas.

Burgeoning population, however, inevitably will place increasing pressure on parts of the world that are now relatively uninhabited but which contain a wealth of natural resources, including water. These are the frontiers of the future and their full use will require pushing further the frontiers of knowledge because the new areas are poorly known and experience in their occupation is small.

LIVING standards in all societies are closely related to water use. High living standards require high rates of water use for agriculture, industry, public services and households. The extent to which developing countries can forge ahead is linked to their ability to develop water resources.

In some countries *per capita* use of water is only about 100 litres per day. In some industrialized countries water use is sixty times greater. The disparity between living standards is even larger.

Lessening of the disparity will require, not only more water use, but more use *per capita*. In view of prospective population growth in developing countries, the problem is formidable. The developed countries themselves have serious problems. Doubling of population may entail doubling of water use merely to maintain existing standards. The situation in the United States of America is illustrative.

Per capita use of water for all purposes other than hydroelectric power generation in the United States is about 6,100 litres per day. This is a very high rate of use compared to that of most other countries, even those which are highly industrialized. However, it is only a small part of the average total national water supply.

In some areas water is re-used many

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times. On the average, however, somewhat more than 90 per cent of the water yield of the United States is not subjected to withdrawal uses. It serves as a conveyor belt to send wastes out to the sea. The central problem of water resources development and management is, in fact, a problem of water quality, not water quantity.

On a continental or regional scale, water shortage in one area may be alleviated by interbasin transfers of water. This will not necessarily alleviate pollution, however. In the basin from which water is exported, the amount remaining to dilute pollution is less. In the receiving basin it may permit additional developments that add to the total pollution problem.

Evidently it is necessary to establish national, and in some cases, international objectives and policies to control and abate pollution, not merely to control and distribute water itself.

The real measure of progress at mid-point in the International Hydrological Decade (IHD) is seen in the effective international co-operation that has developed and the importance of the activities that have been launched or planned. The following are a few examples.

One of the more remarkable areas of South America is the upper basin of the Rio Paraguay, known as the *Pantanal*, which extends along the frontiers of Brazil, Bolivia and Paraguay. In this vast flood plain which extends over an area of some 400,000 square kilometres, Unesco and the Brazilian Government are making a broad survey on which to base a programme of land reclamation and development (see article page 14).

When worked out, the methods of land drainage and development will serve also for similar operations in the Bolivian and Paraguayan areas of the basin. The Pantanal study, in fact, is one of the greatest of the hydrological surveys now taking place in the world. It is part of a long-term international programme of studies for the basins of the Rio Parana and the Rio de la Plata.

Brazil has also set up, within her Hydrological Decade programme, a Centre for Applied Hydrology at Porto Alegre. This has been done with financial help from the Government of Brazil, the National Bank for Economic Development and the United Nations Development Programme (UNDP).

Photo © Paul Almasy, Paris

PRE-POLLUTION ICE-CUBES

Since the end of the last ice age 10,000 years ago, 80 per cent of all water outside the oceans has been locked up in the great ice-caps of Greenland and Antarctica. In the far North, Eskimoes store their drinking water in the form of blocks of solid ice piled up in the open air, above. An enterprising Danish firm is now selling "Pre-pollution era" ice cubes taken from icebergs. Tiny bubbles of air, trapped in the ice thousands of years ago give a sparkling effect to drinks in which the cubes are placed.

The Great Lakes of North America contain one of the largest concentrations of fresh surface water in the world. Canada and the United States have collaborated during many years in studies of many international water problems. Now, for the first time, the two countries are collaborating in an intensified study of the lakes which will have wide implications for navigation, power generation, industrial and municipal development, fisheries, and recreation.

Another remarkable area is the Chad Basin in Africa. The basin is much larger than Lake Chad itself, covering 400,000 square kilometres and extending into the four States of Cameroon, Chad, Niger and Nigeria. Studies in this area relate to the soil, surface-water and ground-water resources.

Although many excellent studies had been made long before the advent of the Hydrological Decade—specifically under the Arid Zone Research Project of Unesco—the Decade has made it possible to collate a wide variety of data.

Through Unesco and the Food and Agriculture Organization (FAO), a Commission formed by the four riparian States obtained assistance from the UNDP. In consultation with the Commission, FAO administers the reclamation studies and Unesco the

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Photo © "Manchete", Brazil

ONE OF THE WORLD'S LARGEST HYDROLOGICAL PROJECTS

The Pantanal

400,000 sq. km. of swampland in the Mato Grosso

by Newton Velloso Cordeiro

TO the west of Brasilia, stretching out over central Brazil and extending into parts of Bolivia and Paraguay, the Mato Grosso swamps form a vast tableland, some 150 metres (500 ft.) above sea level, in the very heart of South America.

Known as the "Pantanal", this huge region, covering about 400,000 sq. kms. (150,000 sq. miles) is dotted with lagoons and hillocks. Through it runs the river Paraguay and its many tributaries totalling over 1,300 kms. (800 miles) in length. During the rainy season rivers and lagoons merge into one sheet of water.

In this enormous area, four-fifths the size of France, the Brazilian government and Unesco are carrying out one of the world's greatest hydrological studies under the auspices of the United Nations Development Programme. Begun in 1966, this project will eventually lead to the building of a new world capable of providing food for millions of people and will facilitate the migration into the interior of the continent of a proportion of the population now concentrated along the coastlands of Brazil.

The first attempts to populate the region were made by the Spaniards in the 16th century when they set out from the La Plata estuary to reach the rich mineral deposits of Peru. But discouraged by lack of economic resources, the vast distances and the hostility of the local population, the Spaniards fell an easy prey to other colonists pushing westwards from Sao Paulo. Not until the discovery of gold in the 18th century was it thought worth while to explore and settle the region.

The decline of the gold mines in the 19th century brought the development of the area to a standstill. The risks involved in exploiting the plant and mineral resources, the difficulty of penetrating the Amazonian forests and the lack of markets eventually led to a sharp drop in population.

The Pantanal, however, offers excellent conditions for cattle-breeding, with its vast areas of grazing land over which herds can wander unrestricted. The exact number of cattle in the region is not known, but is estimated to be between 20 and 30 million head.

With its immense estates, or *fazendas*, its stock-raising, hunting and fishing, the Pantanal is one of the

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NEWTON VELLOSO CORDEIRO *was formerly President of the Brazilian National Committee for the International Hydrological Decade and Vice-Chairman of the Co-ordinating Council of the Decade and was until recently co-director of the bold development project which he describes in this article. The project is being carried out by the Brazilian Government and Unesco in co-operation with the United Nations Development Programme.*

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One of the world's biggest hydrological studies is being made in a swampland stretching from central Brazil into Bolivia and Paraguay. Covering 400,000 sq. km. (see map far left), the Pantanal (as it is known, from the Portuguese for "marshland") is entirely flooded for half the year. The hydrological survey, carried out by Brazil and Unesco in co-operation with the U.N. Development Programme, is part of a programme aimed at reclaiming the Pantanal and developing its resources. A famous cattle-raising centre, the Pantanal has between 20 and 30 million head of cattle. Left, herd crossing a Pantanal water course recalls scenes found in ancient Chinese paintings. Right, "home on the range" —amphibious style.

Photo © Paule Bernard, Paris

richest parts of Brazil. It could also become an immensely productive agricultural centre.

The region also possesses considerable iron and manganese deposits in the Urucum mountains, south of Corumba. The main obstacle to their exploitation is their distance from Brazil's markets and from ports equipped for handling minerals. The use of modern water transport could help to overcome this problem.

Other than air lines, the only means of communication linking the region with the Campo Grande and Sao Paulo is the north-east Brazil railway line. Plans exist for the construction of a huge road network to serve this cattle-raising area, whose production is one of the largest in the world, and also to ensure the distribution of surplus agricultural produce in the future.

The far-reaching hydrological studies project for the Upper Paraguay River Basin was adopted by the United Nations Development Programme in January 1966 and was launched by the Brazilian Department of Land Reclamation in co-operation with Unesco later that year. It aims to reclaim and develop the region, and to serve as a testing ground for new techniques which can subsequently be introduced in Amazonia, Bolivia and Paraguay as well as in areas with similar conditions in other continents.

The Pantanal survey is one of the most significant projects of its kind in the world, and should serve as a model for other regions. Its scope and the variety of activities it covers make it an outstanding example of the type of research project which the Unesco-sponsored International Hydrological Decade seeks to promote.

It also comes under Brazil's own national programme for the Decade, which includes projects for developing the resources of the southern region, expanding the Institute of Hydraulics Research at the University of Porto Alegre and the setting up of a Centre of Research and Training in Applied Hydrology.

Until recently no basic information was available about the Pantanal. There was no data relating to hydrology, hydroclimatology or surface hydrology and it was not until 1965 that the first aerial photogrammetric surveys were made.

To obtain the information needed as a basis for the regional development plan, the current project includes the installation of a hydrometeorological network in the Paraguay basin and research on the hydraulic system governing the Mato Grosso depression and the influence of this system on the Paraguay river.

THE Pantanal project comprises two phases. During the first, which is now under completion, data obtained will be assembled for study, longitudinal profiles of the river Paraguay and some of its main tributaries will be drawn up and a preliminary analysis made of hydrological conditions in the basins.

In addition, a number of automatic recording stations will be set up to measure rainfall and other climatic data, such as the level of surface and ground water, and then radio this information daily to a central station.

Data collected will be used as a basis for installing a permanent network of automatic recording stations during the second phase. The work of Brazilian organizations dealing with the Paraguay basin will be co-ordinated, together with measures taken by the Paraguayan, Bolivian and Brazilian national commissions for the International Hydrological Decade.

During the second phase, due to begin this year, the general survey work begun in phase one will be completed and studies of geomorphological, hydrogeological and ecological conditions, including processes of erosion and sedimentation, will be carried out.

Hydrological data obtained will be analysed and an experimental forecasting system based on a mathematical model will be set up. Maps will be made of certain areas suitable for hydraulics installations designed to promote immediate development.

The project is due to be completed in 1973 at a total cost of some $2,400,000. The United Nations Development Programme is contributing $1,534,500 of this sum, and Brazil will provide the rest.

The scale of operations scheduled for the second phase may be extended if similar surveys are carried out in the Bolivian and Paraguayan *chacos*. In that case events in the Pantanal and the flood areas downstream could be forecast several months in advance.

Once data on the regime of the River Paraguay and its main tributaries is available, it will be possible to begin operations to regulate their flow and levels. A navigable waterway could be formed covering a distance of nearly 3,000 kms. (2,000 miles) which would link up the centres of agricultural production and mineral deposits with the main industrial centres in Sao Paulo and even with towns in Argentina.

The improvement of communications will change today's population pattern of small, scattered groups, and will stimulate economic development. Better financial prospects in agriculture and other activities will lead to improved facilities for cultural and technical education. This in turn will give a great many more Brazilians a chance to contribute directly to the development of their country. ■

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Originality and tradition in American culture

by Charles C. Mark

WHEN Ulysses S. Grant was President of the United States he was widely quoted as saying: 'I only know two tunes. One is "Yankee Doodle" and the other one isn't.' Any discussion of cultural policy in the United States must first come to grips with the popularity of anti-intellectualism and anti-culture throughout its history that is implied by that presidential quote.

To be sure, theatres were built and used before the revolutionary war, concerts were a monthly event in many cities, travelling opera and theatre companies found eager audiences all over the American continent. However, these events and circumstances were almost entirely reflections of an American need to become part of European civilization, to express inner appetites by feasting on the riches of an inherited culture.

It should also be pointed out that pockets of real creativity were active from colonial times forward among subculture groups. The Moravians maintained a rich musical tradition in the forests of Pennsylvania and North Carolina, for instance. When events in Europe forced political exile on special groups as did the French Revolution and the German insurrection of 1848, the United States received a cultural injection as these people carried on traditions of culture as part of their new life.

However, the main stream of American civilization before the twentieth century did not value the arts, particularly American manifestations of the arts. Only a small percentage of the population showed concern for artistic quality and permanence. The majority made new art as they pioneered a new country and it was decades before these novel expressions were allowed stature.

Three points must be borne in mind in order to view American cultural history properly. Most important is the fact that the United States was entirely a nation of immigrants imported from other cultures. The only indigenous culture was that of the Indians who were driven from their land and destroyed as a people. American folk culture as it developed with time (and it did develop) is a synthesis of European, African, and to a much lesser extent, Asian culture.

The second point relates to the importation of other cultures and the predominant motivation of the early settlers. Essentially, the United States was a nation of farmers until the mid-nineteenth century, a nation which colonized and exploited itself. Its cities were trading and supply centres for the trek west to new lands. People came from small, soil-poor farms of Europe directly to the endless rich prairies where they could own as much land as they could cultivate and protect.

These were hardy, frugal, hard-working yeomen willing to struggle against man and nature, but cultivated music, dance, or painting were not part of their lives. They brought their peasant culture with them and practised it in the settlements they built to resemble "home". Europeans are often astounded today to find that there are whole areas of some states where English is not the common language, but rather German, Norwegian, Italian or Basque.

The third factor influencing cultural growth in the United States was the Protestant religions. Beginning with the Puritans whose beliefs allowed for only service to God and one's occupation, the other developing sects added fine variants aimed at repressing instincts toward the arts. All of the arts were expressly forbidden by the Puritans, including bright colours for clothing. As late as the 1870s, the leaders of the Baptist, Methodist and Presbyterian religions were debating the appropriateness of family recreation, not to mention theatre, dancing, or popular entertainments. In 1872, the Methodist Episcopal Convention passed by majority vote a list of "amusements", including every form of art, that were forbidden to all Methodists.

With these three conditions against American culture, how is it that the arts managed to survive at all?

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CHARLES C. MARK *is Director of the Office of State and Community Operations at the National Foundation for the Arts, in the United States.* *The author presents a complete survey of this subject in " A Study of Cultural Policy in the United States ", published last year by Unesco in the series: "Studies and Documents on Cultural Policies."*

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Photos USIS

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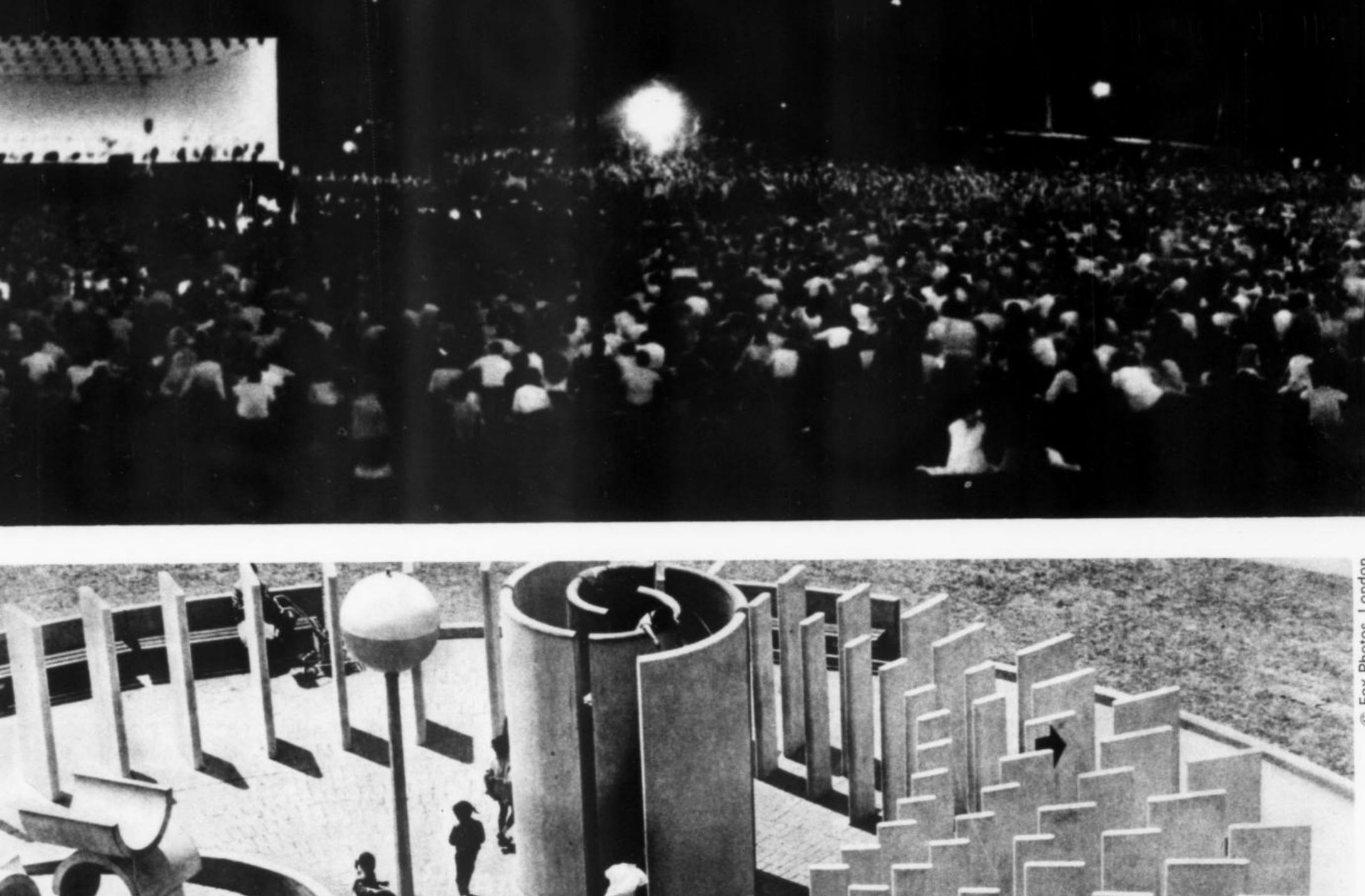
NEW YORK'S CULTURE IN THE ROUND

Open air concerts draw vast audiences to the parks and concert stadiums of the United States. Right, 70,000 New Yorkers listen to an evening symphony concert in Central Park. Below, part of the unusual continuous circular gallery of New York's Guggenheim Museum which houses an outstanding collection of paintings, sculpture and other works of art. Founded in 1937, the Museum was established in its present ultra-modern home, designed by the famous American architect, Frank Lloyd Wright, in 1959. Below right, "Stonhenge in Brooklyn", a new playground sited in the heart of a low-income housing project in Brooklyn. Sponsored by the New York City Housing Authority, it has vaults, sliding towers and a maze to intrigue the youngsters. Its vertical concrete slabs recall the ancient "standing stones" at Stonehenge, in England.

Photo © Bozak - James A. Ford Agency

Photo © Etienne Hubert - Rapho, Paris



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From the birth of a nation to the rhapsody in blue

Fortunately, the new continent poured forth riches beyond anyone's dreams and wealth meant travel. Sons were sent back to England to be educated, wives went to France on shopping trips. European merchants, craftsmen, and finally artists found opportunities by serving the wealthy. One German architect designed and built over fifty of the most gracious plantation mansions in the south, training slaves at each place to be carpenters, woodcarvers and joiners. And taste began to breed taste.

HOWEVER, the Industrial Revolution is responsible for the most influential and most debatable cultural movement. A period of 57 years, between 1860 and 1917, saw the founding of most of the United States quality institutions of the arts. The Metropolitan Opera, the Metropolitan Museum, the New York and St. Louis orchestras, were among the earliest, but by the time of the First World War most of the famous schools and institutions were established.

This was, however, imported culture. It was an attempt to ape the capitals of Europe, not to develop an American cultural life. Considerable evidence points to the fact that many of the wealthy who established, attended, and carefully guarded these institutions from any infusion of the lower classes did not really enjoy the experience of art.

However, at the time when the industrial barons were buying culture packaged in Europe, other social changes were taking place. The country was turning from an agricultural society into an urban one. New waves of immigrants were arriving from Europe, this time to stay in the cities and find places for their lives. Whole sections of large cities became foreign to native Americans and some remain so today.

In addition, rural people joined the urban migration and began fighting for the factory jobs. It was this phenomenon that struck at the village and family-oriented Protestant religions. Thousands were attending the low-priced and continuous vaudeville shows and the leading clergy were forced to choose between retracting their position on entertainment or watching the American family disintegrate as the younger generation preferred the orchestra seat to the church pew.

This was a major debate in the nation from 1880 until 1915, by which time entertainment was so widely accepted that the few remaining "village" preachers were ignored.

As one leading clergyman after another crossed over the box-office threshold, the vaudeville entrepreneurs made every effort to hold their endorsement by providing elevating and polite acts in their theatres. It was during this period that American taste and humour was developed and distilled. This was also the period when the sexless, non-controversial content of Hollywood films was perfected. Vaudeville added films to the acts presented in the early 1920s. Since the theatre-owners prided themselves on the "family entertainment" motif of their attractions, the Hollywood film-makers produced films aimed at these major markets.

Meanwhile, indigenous culture was growing untended and unappreciated. Theatrical and musical performances abounded from the early seventeenth century and were attended by rebellious Protestants, European-oriented Americans, and members of minority religions, but native creative talent and ideas were not valued as comparable to any work or artist of European origin. Church opposition kept many talented people from embracing the artist's life, although literature and painting were not always included on lists of forbidden pastimes, and American authors and painters sometimes found sympathetic acceptance at home so long as they followed European traditions. However, through the nineteenth century, from Benjamin West to Mary Cassatt and Henry James, Europe had the climate that claimed America's most original and talented artists.

What are the uniquely American contributions to world culture? Only when the contributions had been envied around the world did Americans recognize them and begin to believe that this culture could produce its own art. Three individual art forms became labelled as distinctly American in the early twentieth century: jazz, a unique form of dancing, and the musical comedy. All three came out of conditions of suppression. All three evolved from a folk subculture that was expressed freely, but held unacceptable by the main stream of American society until after it was applauded wildly in other countries.

Jazz, as is widely known, was born of a European mother and a African father. Slaves and freed Negroes picked up European instruments and melodies and added rhythms and musical organization as they felt it. From the funeral processions and brothels of the south, it spread north and east until the world danced to the blues. It influenced European composers and then serious American composers began legitimizing its sounds.

A jazz dancer tapped his feet to complex rhythms and the enthusiastic approval of audiences all over Europe, including Queen Victoria, about 1850. At that time no respectable American gentleman would have admitted having seen Juba (William Henry Lane) or anyone who danced in his style. Isadora Duncan, fifty years later, was practically driven from the country for ideas about free movement and rhythm. These roots led to so-called modern dance which existed as an underground culture until forty years ago, and only recently attracted a stable audience.

MUSICAL theatre began in America before the revolutionary war, and evolved steadily from the first professional all-American musical, *The Archers*, first performed in 1796. One reason for an almost tyrannical preoccupation with combining plays with music was the opposition of local governments (church inspired) to "straight" theatre. It was assumed that music had a certain moral tone and no play could be really bad if it had songs connected with it.

Minstrel shows, showboats, travelling troupes, and even circuses found musical plays a popular part of their repertory with the rural and frontiersmen audiences. Partly due to the tradition established in the east in the eighteenth century, but also probably because Americans have an inexplicable love for gay melodies, the musical grew and flourished and became the standard of the world.

By the second decade of the twentieth century, when the United States came to realize its relative strength among nations, its people at the same time realized that a traditional American culture did in fact exist, or was rapidly developing. The years of the 1920s saw an enormous burst of artistic energy from American

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artists. As evidence, Americans had been winning Nobel Prizes in science and peace since the beginning of the award in 1901 (Peace Prize, 1906; Physics, 1907; etc.); but not until Sinclair Lewis won the Literature Prize in 1930 had an American artist received such world acclaim. Since then, five Americans and one author who was born and educated in the United States (T. S. Eliot) have been honoured.

THE point of this capsulized social history of the arts in America is that to speak of cultural policy as an extension of traditional culture is a difficult undertaking in the United States. Many countries have undergone periods of cultural encouragement and discouragement in the course of their history. They have seen their folk art evolve from the first primitive tribes to settle in their regions at the dawn of time. Other nations have seen their cities become established as centres of culture and commerce and remain such centres century after century. And they have proudly acclaimed their mature artists as they emerged from mature artistic institutions and societies. All these events and circumstances are not applicable to the United States.

Its history began with the cultures of many countries severed from the traditional roots. Art was officially discouraged by the powerful and almost universal fundamentalist religions. The nation was scattered in the wilderness for its first hundred years. Cities of sophistication in the eighteenth century became ordinary towns as the centre of national life moved west. (Charleston, South Carolina, and Savannah, Georgia, were once extremely important national cultural capitals.) New Orleans lost its excitement to St. Louis; St. Louis lost its place to Chicago as the railroad replaced the riverboat. No repertory theatre to date has managed to hold together for 25 years, only two orchestras can boast of 100 years of existence.

Indigenous American culture did not clearly become definable until the twentieth century when American composers, playwrights and authors began to find the unique American beat in their work. It came from the Indian ceremonies and the restlessness of the pioneer families, but its expression as an instinctively understood interpretation had to wait until the land was conquered.

All this not only affects the scope of a cultural policy, but also affects

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THE EXPANDING ARTS IN THE U.S.A.

The United States boasts 1,200 community orchestras, 30,000 amateur theatre groups and between 10 and 15 million amateur painters as well as countless ceramists, weavers, lapidists, etc.

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There is virtually no town in the U.S. of 5,000 population that does not have an adequate general public library augmented by a state library system. It is estimated that about 10 per cent (20 million) of the population reads intensely while a larger proportion reads books only occasionally. University publishing houses now make up an important segment of the American book world.

★

In addition to commercial television the U.S. has 140 public T.V. stations which broadcast only educational and cultural programmes. Recent legislation provides federal funds for a quasi-public organization to weld these educational T.V. stations into a single network.

★

An American Film Institute was launched in 1967 with a $5.2 million fund made up of contributions from federal funds, private foundation grants and commercial film corporation gifts. The Institute trains young people for the profession and works with colleges on film-study courses and the promotion of the film arts. Funds are provided for unusual feature films by young directors. 150 U.S. universities offer courses in film study and appreciation.

★

Resident professional theatre groups are spreading across the U.S. By 1968, fifty cities had resident companies performing high calibre Broadway and standard classics. Some of these companies also try out new or controversial plays. A new emerging theatre force is the "theatre-in-the-street" movement. The movement is concerned with social aspects of theatre and the cultural development of lower income groups. Standard modern works and classics, original dramas and improvisational works are performed from mobile truck theatres, on street corners, in churches, schools and open fields. Budgets are precarious and support comes largely from public and private grants.

★

There are now 28 major symphony orchestras in the U.S. These and an additional 40 smaller orchestras have received grants totalling $82 million for the establishment of endowment funds.

★

Some 200 cultural centres have been built in the U.S. since 1950, but a National Endowments for the Arts study estimates that $7,500 million would be required to equip the nation with all the facilities needed for the arts. Such centres are usually financed by contributions from local private and public resources with occasional federal or state participation. Some more unusual methods have been adopted: the state of New Jersey financed the Garden Arts Center from expressway tolls; Huntsville, Alabama is paying for its cultural centre by a municipal liquor tax; in Tacoma, Washington, a city jail was given over for an arts centre.

★

About 85 per cent of all contributions to the arts in the U.S. come from private individuals, foundations or other corporate sources. About 1,500 foundations make grants to the arts totalling about $60 million annually.

★

There are 350 art museums in the U.S. and about half of them have continuing programmes in one of the art forms in addition to the visual arts.

★

A survey of 221 U.S. cities conducted in 1967 concluded that more new buildings for the arts have been completed in the past five years than in any other period in U.S. history. Seventy-one cities have buildings for the arts under way; 36 museums, 34 theatres, 23 arts centres and 7 concert halls have been built for 70 American cities in recent years. ■

Photo USIS

Jazz is one of the uniquely American contributions to world culture. The driving force that was to give jazz its impact came from the Black street musicians of the big cities. One of the best known of these early groups was Joe "King" Oliver's Creole Jazz Band, pictured left in San Francisco in 1921. Below, listening through earphones, a fan enjoys a modern stereophonic jazz recording.

the ability to evaluate and effectively plan long-term programmes even if a defined political philosophy made such planning possible. Instead, as stated at Unesco's 1968 Round Table Meeting on Cultural Policies, in Monaco, "Cultural needs are evolving more quickly; new needs are appearing, and public taste changes... One must, therefore, avoid choosing a framework which may become too narrow and preserve the possibility of a flexible adaptation of resources to the requirements of a rapidly evolving cultural scene." This must be the American position.

The events sketched lightly here are generally the cultural heritage for which contemporary cultural leaders of the United States must account as policies and programmes progress. By all signs, the United States is well into a most incredible artistic naissance. The historical maturity has caught up with the experiences of the world situation. The economic strength of the nation is capable of sustaining any artistic effort, and its international commitments demand an ever deeper involvement with other countries in all enterprises, including intellectual and artistic. In addition, far in advance of other nations, the United States has encountered the extreme effects of the Industrial Revolution, the imminent realization that man is or may be mechanically obsolete. It is already glaringly evident that America cannot control some of the situations into which its technology has placed it. This is a time in American history that cries for the humanistic influence in life. The United States seems to be moving toward a full realization of the importance of culture as a counterweight to technocracy. ■

Photo © Photo Researchers Inc., New York

Emblem of the lunar module "Eagle" in which U.S. Astronauts Neil Armstrong and Edwin Aldrin made the first moon landing in July 1969, during the Apollo 11 space mission.

Photo USIS

THE EAGLE

'spacecraft' of the pre-scientific age

by José Patrocinio de Souza

WHOEVER conceived the idea of naming the Lunar Module which landed the first men on the moon, the "Eagle", displayed, consciously or unconsciously, a remarkable sense of history. For, man being carried into outer space by an eagle, or man ascending to the astral regions in the form of an eagle, was a widespread human fancy in the pre-scientific age.

It is true that the Athenian comic dramatist, Aristophanes, caricatured the belief in his play *Peace*, by sending his hero up on the back of a dung-beetle. Aristophanes notwithstanding, the eagle fancy persisted, giving rise to a succession of myths and to works of art illustrating them.

This flight of early man into space was, of course, a flight of his imagination. But the spacecraft "Eagle" has transformed myth into reality and made the ancient dream come true, thus linking two principal epochs in the history of man—the Age of Faith and the Age of Science. And, whether real or imaginary, the object of man's flight into space has been fundamentally the same throughout history. "Man was voyaging to the planets," says Norman Mailer in his forthcoming book *A Fire on the Moon*, "in order to look for God. Or was it to destroy Him?"

But why did the ancients imagine that the eagle would be able to carry man into outer space? To the people, who lived, worked and had their being in and through symbols, the eagle was the sky-bird *par excellence*. Dwelling at inaccessible heights and soaring higher, perhaps, than any other bird, the eagle was flying, so it seemed to their lively imagination, towards the sun and merging itself with the sky. It thus became to them a fit attribute and vehicle of their sky and solar

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JOSE PATROCINIO DE SOUZA, *Indian historian and writer, is head of the Department of History at Elphinstone College, Bombay, the oldest university college in western India. Professor de Souza has made a special study of the origins, migration and meaning of symbols, particularly the universal symbols of the eagle and the serpent. He is preparing two books in this field: "The Symbol of the Double-Headed Eagle: Its Origin, Diffusion and Significance" and "The Eagle and the Serpent: A Study in Symbolism."*

Soaring through ancient mythology and legend

Right, carved silver plate dating from the Sassanian epoch in Persia (3rd to 7th century A.D.). A sky-eagle holds Anahit, ancient Persian goddess of fertility who also personifies the planet Venus.

Left, designs carved on a gold bowl found at Hasanlu, in Iranian Azerbaijan, represent episodes from the lives of the gods and battlefield scenes. At centre, an eagle carries off a man on its back.

Illustrations by courtesy of the author

Right, a two-headed eagle carrying a prince into space decorates this Iranian silk cloth (11th-12th centuries A.D.). The double-headed eagle has a long and ancient history in the heraldry of many countries of Asia, Africa and Europe.

THE EAGLE *(Continued)*

deities, such as Zeus of the Greeks, Jupiter of the Romans and Vishnu of the Hindus.

The eagle as the symbol of the sky is graphically represented on a Sassanian carved silver plate now preserved in the Hermitage Museum, Leningrad. A spread eagle is depicted as holding by the hips a nude woman with pomegranate breasts. In her right hand she holds aloft a plate of fruit, apparently pomegranates. Scholars have identified this figure with the old Iranian fertility goddess, Anahit.

But Anahit also had a specific astral significance: she was the personification of the planet Venus, the morning star. The motif may thus be taken to represent the sky in the form of an eagle "presenting its loveliest planet." Although the design belongs to Sassanian times, the conception of the sky-bird synthetized with an anthropomorphic astral deity dates back to the second, or more probably, the third millennium B.C.

Moving, as it seemed to the ancients, between earth and heaven, the most majestic of birds was conceived by them as carrying kings and heroes from earth to heaven, or as being sent down to earth by the gods to take up their favourites thither. The mythologies of many nations are rich in stories of high-ranking personages being transported to the astral regions by the eagle.

The oldest, perhaps, of these myths is the much-travelled tale of the Mesopotamian hero, Etana who was the first man to go "where eagles dare." According to the early Sumerian chronology, this prototype of the modern astronauts was the thirteenth king of the First Dynasty of Kish after the Great Flood.

Etana's flight into outer space, clinging to the pinions of an eagle, is the theme of the Legend of Etana, a fascinating poem in cuneiform, which has survived in a later copy, fragments of which were recovered on some clay tablets from the library of the Assyrian monarch, Assurbanipal. They were first published by George Smith in his remarkable book, *The Chaldean Genesis*, and added to later by other scholars.

The occasion for Etana's flight into space was his quest for "the plant of childbirth," which would cure his wife of her barrenness. Etana had been looking high and low for this miraculous herb, but in vain, so he appealed to Shamash, the Sun-god, to help him find it.

The god directed him to a certain eagle, which Etana found lying in a pit badly bruised in a fight with a serpent, its traditional cosmic antagonist. Etana tended the wounded bird with all the care he could bestow on it. Thanks to his ministrations, the bird's wounds were healed and it regained its strength. Out of gratitude to the king, the eagle undertook to carry him to the courts of Ishtar (Venus), the goddess of childbirth, and thus addressed him:

My friend, lift up thy countenance,
Come and let me carry thee to the heaven of Anu.
On my breast place thy breast,
On my pinions place thy palms.

At the eagle's bidding, Etana, old though he was, taking courage into his hands, "set his breast against the breast of the eagle, and laid his hands on the feathers of its wings." Then the eagle took off without making much noise—unlike Apollo-11—with the old man clinging to it for dear life, and soared higher and higher, pointing out on the way "the vast dwindling panorama of earth and sea."

At last they reached heaven, and passed through the courts of Anu, Enlil and Ea, but the throne of Ishtar was still higher up. It was now six hours that they had been going up without a stop, and Etana, either because his courage failed him or because he felt giddy, ordered the eagle to halt and take him back to earth. Unfortunately, the text is badly defaced here, and the poem ends with the sad account of the "spacecraft's" crash landing.

On numerous cylinder seals dating back to the Dynasty of Akkad, third millennium B.C., is depicted a strange scene which many scholars have interpreted as illustrating the flight of Etana into space, though on these seals a bearded man is seen riding on the back of a bird, whereas according to the Legend of Etana, the patriarch was carried up clinging to the pinions of an eagle.

The bird on these seals is probably an eagle, taking off with a bearded man, possibly Etana, on its back. Immediately below the eagle is a dog, or, more commonly, two dogs seated or standing face-to-face on either side of a bag or vessel, evidently belonging to the patriarch. They are frequently depicted looking up in surprise at their master. Another interesting feature of these representations is the flock of sheep.

These details leave us in no doubt that the man on the back of the eagle is a shepherd. This is hardly surprising, for in the King-lists Etana bears the name of Shepherd. Other shepherds, too, are often shown expressing their amazement by lifting an arm in the attitude of wonder.

This ancient Mesopotamian tale and its illustrations in Sumerian art travelled widely, for Mesopotamia lay at the cross-roads of the ancient cultural world. The motif first migrated to Iran. On an Iranian shell cylinder, contemporaneous with the Akkadian seals, a mythological scene is depicted. Above a seated female figure, with snakes emanating from her shoulders, appears an eagle over one of whose wings a human head is seen. This design has been taken by some scholars to be a rendering of the myth of Etana in an abbreviated form.

There is yet another, and better, illustration of the legend in Iranian art. It is carved on a magnificent gold bowl dating back to the second millennium B.C. This rare object was discovered by Robert Dyson in 1958 at Hasanlu, in Iranian Azerbaijan in the course of an archaeological expedition led by John Dyson. In the elaborate scene depicted on the bowl we see an eagle in full flight carrying off a human being, recalling the Mesopotamian myth.

The tradition of Etana's flight survived in later tales, notably in the story of Alexander's flight into space. Among the many wonderful exploits attributed to Alexander the Great is the one of his making himself small and flying through the air perched on the back of an eagle till he reached the "heights of the heavens," which he explored. From that altitude Alexander was able to acquire a knowledge of the dimensions of the earth, and of the seas and mountains that he would have to cross in his march of world conquest.

The Koran relates that a Babylonian king held a disputation with the Hebrew patriarch Abraham concerning "Abraham's Lord". Commentators on the Koranic text have identified the monarch with Nimrod, who afterwards caused Abraham to be cast into a fire, from which, however, he was miraculously delivered. Thereupon, Nimrod built a tower so as to ascend to heaven to see "Abraham's Lord" and make war on him, but the tower was mysteriously overthrown.

But Nimrod did not give up his attempt and had himself carried up in a chest drawn by four monstrous, eagle-like birds, then after wandering for some time in space, he fell down on a mountain with such great force that he made it shake.

A similar story is told in the great Iranian epic, the *Shah-nama*, about King Kay Kaus who was lifted up into space in a car to which were harnessed four eagles, one at each corner, which flew upwards in their efforts to reach the lumps of flesh attached to the upper parts of the car. There are several examples of the illustration of this legend which may be referred to a Sassanian original, the best known of which is the marble slab inserted in the northern wall of San Marco in Venice.

Echoes of the Etana myth are also to be heard in the *Arabian Nights*

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King Etana, a Mesopotamian hero of the Kish dynasty, is carried by an eagle up to heaven in search of the plant of fertility. Detail from a Sumerian seal from the third millenium B.C.

The griffin through the Great Golden Gate

Entertainments. During his Second Voyage, Sinbad the Sailor tied himself with his turban to the legs of the fabulous Rukh or Roc, an eagle-like bird, which flew up into the air carrying Sinbad with it. It soared so high into space that poor Sinbad lost sight of the earth and it seemed to him as if he had reached the very limit of the sky. The bird, however, descended, till it alighted on the top of a hill.

Great adventurer that he was, Sinbad had yet another opportunity to fly into space. In the course of his Seventh Voyage, he found that in a certain town at the beginning of each month the townsmen were transformed into birds and flew. Sinbad induced one of them to carry him on his back, but the man, or rather the bird, flew so high that Sinbad could hear "the angels glorifying God in the heavenly dome."

In Tibet there is the story of a Griffin a fabulous animal with lion's body and eagle's beak and wings, which rewarded the hero by taking him upon its back and flying straight through the "Great Golden Gate", where it deposited the youth in the centre of a vast courtyard round which sat numerous gods, fairies and "other denizens of the sky." Similarly, in Swedish folklore the Phoenix, the fabulous eagle-like Sun-bird, once carried a youth on its back to "the beautiful Palace East of the Sun and North of the Earth."

The Etana myth found a spiritual expression at Rome in the apotheosis of the Emperor. We get a detailed account of the ceremonies connected with the deification of the Roman Emperor from Herodian's description of the obsequies of Severus, which Herodian apparently witnessed. The most significant of the funerary rites was "the liberation, at the moment of kindling the funeral pyre, of an eagle which was supposed to bear the Emperor's soul to heaven."

Apotheoses of emperors and members of the imperial family were recurring motifs in Roman art. The eagle is an indispensable part of these representations. Among the better known examples are the apotheosis of Titus sculpted on the Arch of Titus and that of Augustus on a grand cameo in the Louvre. Bronze medallions of Antoninus Pius have "Consecratio" inscribed on their reverse, and the emperor with a himation (draped garment) wrapped about his legs and a sceptre in his right hand is shown being carried aloft on the back of an eagle. On some Roman coins the apotheosis of Faustina is represented.

There is a story in the *Mahabharata* which is reminiscent of the apotheosis of the Roman Emperor. After a brave warrior named Bhurishtrava died on the field of battle his soul was carried to heaven, on the order of Krishna, by Garuda, the giant eagle of Hindu mythology and the mount of Vishnu, as of Krishna, his incarnation. Similarly, the soul of the Celtic hero Lugh-Llew Llaw in the *Mabinogion*, flew up to heaven as an eagle when Lugh-Llew was killed by the tanist (his heir), at midsummer.

The archetypal myth of the eagle carrying kings and heroes up to heaven has its reverse version in Iranian mythology. Rustam, a sky hero, was brought by the Simurgh, a fabulous bird of the eagle species, in the opposite direction—from heaven to earth—to be one of the first monarchs of Iran.

In Greek mythology also there is the story of the Sky-god Zeus coming down from heaven in the form of an eagle and abducting Thaleia, a nymph of Mount Aitne in Sicily. This legend is illustrated on a red-figured vase-painting from Nola, Italy, which shows Zeus as a mighty eagle in a blaze of celestial splendour carrying Thaleia from earth to heaven.

But the myth of the eagle of Zeus coming down to earth and carrying off a mortal, which gained immense popularity in Greece and later in Rome, is that of Ganymede the son of Tros, who gave his name to Troy. Because of his dazzling beauty, this youth was carried off from earth to heaven to replace Hebe as cup-bearer to Zeus. There are several versions of this myth, variously describing the manner in which Ganymede was kidnapped. But the most popular version has it that he was carried off by the eagle of Zeus.

The rape of Ganymede was a favourite motif in Greek art. The most celebrated and, by all accounts, the most typical representation of the myth is the Ganymede group in bronze by Leochares, an accomplished Attic

A bronze medallion of the First-Second century A.D. showing Jupiter's Eagle bearing off to heaven the Roman Emperor Antoninus Pius (86-161 A.D.) while the people of Rome (symbolized) look on in wonder.

Illustrations by courtesy of the author

sculptor of the fourth century B.C. Although the original, praised by Pliny, has been lost, several copies of this work have survived the ravages of time. The best of them is the marble copy in the Museo Pio Clementino at the Vatican.

The presence of the dog in the Leochares sculpture reminds us of the Etana scenes on the Sumerian cylinder seals. So does Virgil's description in the *Aeneid*, Book V, of the design embroidered on the robe awarded to Cloanthus, the winning captain in the boat race. In Dryden's translation the passage reads:

There Ganymede is wrought with living art,
Chasing through Ida's groves the trembling hart,
Breathless he seems, yet eager to pursue,
When from aloft descends, in open view,
The bird of Jove, and sousing on his prey,
With crooked talons bears the boy away.
In vain, with lifted hands and gazing eyes,
His guards behold him soaring through the skies,
And dogs pursue his flight with imitated cries.

There are several adaptations of the Ganymede group by Leochares in the Graeco-Buddhist art of Gandhara. In these specimens, Garuda is shown seizing a Nagini after the manner of the eagle in the Vatican copy of the Leochares masterpiece.

IN the Iranian art of the early Islamic Period, representations of a youth being carried up by an eagle seem to have been influenced, by the Ganymede sculpture of Leochares. But they are also in line with the primitive Iranian tradition of the sky-eagle being synthetized with the sky-deity.

Two examples deserve particular notice. One is on a tenth-century bowl in the Kelekian Collection at the Victoria and Albert Museum, London. A spread eagle is depicted on the inside of the bowl, carrying off a hero who is extended over the body of the bird and is clinging to it. A striking feature of this design is the dog shown within the double border round the eagle.

The other example is even more remarkable. It occurs as a decoration on a twelfth-century white silk compound cloth in the A.D. Bliss Collection. Here the eagle is double-headed and carries off a prince, who clasps with both his hands a circlet passing round the neck of the bird.

Indian mythology is not lacking in stories of the eagle being sent down from on high to carry mortals to heaven. There is, for instance, the story related in the *Mahabharata* of a king called Vasu Uparichara, who was deeply devoted to Narayana (Vishnu). When his time was up, "renouncing his body", Uparichara ascended to heaven. After having had a taste of heavenly bliss, however, the poor man tumbled down from paradise and "went down a hole in the earth."

This came about through the curse of the Brahamanas, whose wrath Uparichara had aroused when he acted as an arbitrator in a dispute between them and the gods regarding the proper method of offering religious sacrifices, and had the temerity to give his award in favour of the gods.

Although, like Lucifer, Vasu had fallen so low, he did not, unlike Lucifer, give up his faith in God (Vishnu) but continued to worship him as fervently as before. Being highly pleased with Uparichara who thus showed himself to be entirely devoted to him and dependent on him as his sole refuge in distress, Vishnu ordered his mount, the swift Garuda, to rescue the fallen king.

In an unparalleled diving operation, Garuda swooped down into the pit in which Vasu was lying and, lifting him up, it soared into the sky and there released him from its beak. In this way, thanks to the eagle of Vishnu, Vasu Uparichara re-entered heaven and regained his divine form.

By a strange coincidence, there is also an intimate connexion between the eagle and the moon in Indian mythology. According to the Rigveda, it was Suparna, "the fair-wing'd one", which is but another name for Garuda, that brought Soma to man. Now, in the Veda, Soma means the exhilarating celestial drink. But it also means the moon, which was supposed to hold the life-giving, wisdom-imparting nectar.

Sad to relate, the moon which the "Eagle", unlike the bird of legend, has brought within human reach is a dry and dusty planet without so much as a drop of water, let alone nectar, in its so-called "seas". And to think that there was a time when man imagined the moon to be a bowl of liquid, so that Shakespeare could fancy "young Cupid's fiery shaft" being "quench'd in the chaste beams of the wat'ry moon!"

Verily, the "Eagle", while it has enabled man to realize one dream, has shattered another. It has completed the process of stripping the moon of all the romance with which, from times immemorial, man had draped it, and has exposed it for what it really is—an ugly, pock-marked planet, devoid of vegetation, unfit for normal human habitation, without the faintest resemblance to its personification as the beautiful Selene by the ancient Greeks. Aptly did Thomas Campbell versify:

"Tis distance lends enchantment to the view,
And robes the mountain in its azure hue."

■

Garuda, a fabulous bird, carrier of the Hindu god Vishnu and mortal enemy of the genii of land and sea, carries of a Nagini, a female sprite. This Gandhara bas-relief probably dates from the 4th century A.D.

The five crises of the university

by James A. Perkins

THERE is not just a single crisis of the university, there are several crises. What we must recognize is that any one of them by itself would be enough to cause serious trouble. The second point is that these crises are closely related to one another. Thirdly, their solution will probably require a major change in the organization, structure and mission of the university.

The first crisis is of course the crisis of numbers. Throughout the world the largest *numerical* increase in educational growth is at the primary and secondary level, but by all odds the highest *percentage* increase in educational growth is at the level of higher education.

While experiences differ from country to country it is safe to say that on the average the number of students entering higher education has doubled in the decade from 1960 to 1970.

Even this swollen number will at least double in the next decade. If there were no other problems, this astonishing growth would, by itself, result in almost intolerable strains on most institutions of higher education in most countries.

The root causes of this increase are to be found in the requirements of modern technological society. The need for trained or even semi-trained manpower is unending. No country and no people have a chance of entering the modern world with only a small fraction of the population attaining the equivalent of a secondary school degree. And no country and no people can hope to provide the leadership necessary for a modern society if only a very small fraction acquire the equivalent of a college or university degree.

It is of course unwise to be too specific about what the threshold figures for advanced education should be for any particular country. But for this writer 30 per cent of the relevant age group going through secondary school and 5 per cent of the relevant age group going through the university are the threshold figures for a modern society.

This does not mean that with 30 per cent acquiring secondary school degrees and 5 per cent acquiring university degrees the country has adequate manpower for the modern world. It means simply that until these figures are reached a society has today little chance of entering on the current world stage. Furthermore, larger percentages than these will be necessary for those countries who would lead.

It is a sombre note that progress toward even those limited objectives has not been uniformly steady. Large parts of the world are nowhere near these threshold figures, and in many countries, expanded higher and secondary education must be viewed against the backdrop of the battle against illiteracy, which is not being won. This year there are almost 800 million adult illiterates in the world —a heavy anchor that the developing countries must drag with them as they struggle towards modernization.

Nevertheless, most countries have democratized their secondary education. Heretofore, in many places, secondary education was the selective and narrow route through which entrance to college and university was determined. Admission to the university was really controlled by careful selection for secondary school through examinations taken at the ages of 11 or 12. Under these arrangements, it was quite possible for countries to follow a principle of permitting all secondary school graduates to enter the university.

With the widening of admissions to secondary education, however, traditional policies of automatic entry into university have led to enrolments that, in many cases, are almost grotesque. Over 100,000 students are enrolled in the Universities of Paris and Mexico apiece.

Those countries that have tried to regulate this tide by turning aside large fractions of the new graduates from secondary school have run into much social opposition, which has been matched only by the reaction of students who have been admitted to find no places prepared for them.

The central fact about numbers is that we have opened wide the gates to secondary education but have planned higher education on the traditional bases of professional standards and high selectivity. It is this mismatch of numbers and of social doctrine that is at the core of the crisis of numbers. We are trying to pour the ocean into our wine glasses and we are getting wet.

The second crisis of the universities is that of finance, which stems directly but not exclusively from the crisis of numbers. Because we were prepared neither in doctrine nor in administration for the doubling of our student entrance during the decade of the Sixties, we are suddenly faced with large demands for funds, for which neither fiscal policy nor tax structures were adequately prepared. The result has been shortages in every part of the system, including both manpower and money.

The budgets of the universities have gone up not only to accomodate a doubled enrolment within a decade but also to deal with the improvidence that comes from continuing old patterns which are unnecessarily expensive. The shocking fact is that the productivity of higher education has not improved during this decade, the per capita cost of student education has increased, and the effect of these multiplying factors and soaring budgets has fallen largely on the public treasuries—indeed, in most countries, exclusively on the public treasuries.

As a result of these twin crises of numbers and costs, there is hardly a university in the world that is not in financial difficulty that runs all the way from serious to catastrophic.

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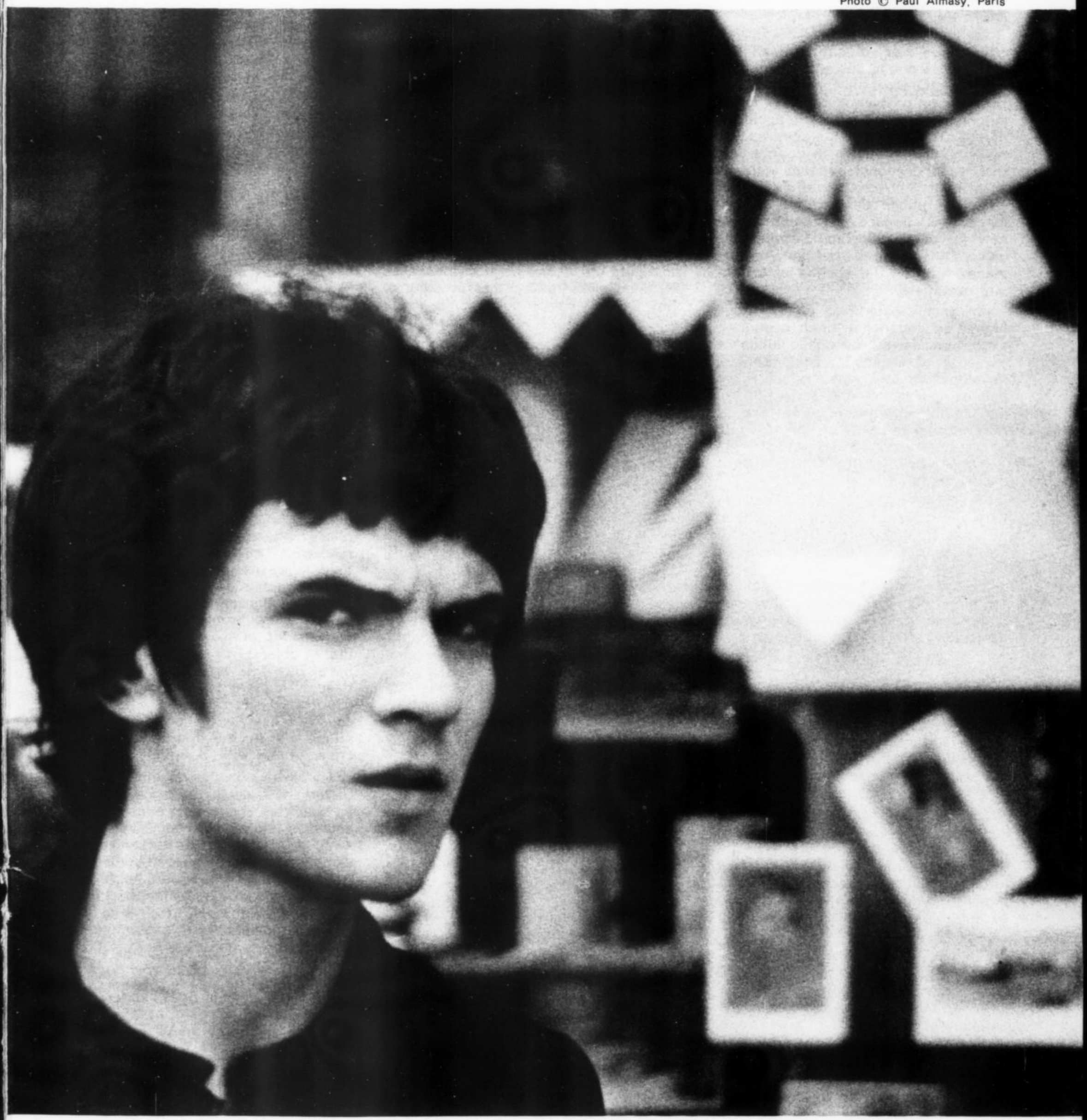

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The paradox of too much success

The consequences are not difficult to discover. The first is an enormous increase in the use of public funds. Tuition rates have steadily increased. Yet, in those countries that have financed a substantial part of higher education from student tuition, the percentage of the total cost it is able to support has steadily declined. Public money has become an increasingly important element in every budget.

Another consequence of the university crises has, of course, been an increase in public surveillance of academic expenditures—which has in turn raised deep problems about the future autonomy of individual institutions and of the whole educational system. It takes no crystal-ball gazer to anticipate that, as educational budgets increase as a fraction of total government budgets, the public demand for surveillance will increase. Thus, a whole new set of relationships between the university and the central governments stands high on the agenda of university managers.

For many countries, if not most, higher education has been supported almost exclusively by public funds as a matter of tradition. For them the development of new relationships between university and state will not be so difficult but they are already experiencing the effects of the public demand that their governments exercise tighter control over academic expenditures.

For those countries where a large part of higher education has been privately financed, as in the case of the United States, Japan and India, an increased dependence on public funds creates a brand of academic trauma. To surrender independence because of financial need is rarely a graceful exercise.

The third crisis is that of relevance. Several points are important here. The first is that traditional education offers little nourishment for the most crucial needs of new countries, or for the needs of some older countries now in the process of modernization.

The Latin American universities, for example, with their heavy emphasis on law, medicine and letters, have not seemed completely relevant to the new thrust of student demands for appropriate preparation for the managing of societies that are both democratic and technologically sophisticated.

In the U.S. as well as other countries, it is the students who have presented the university with the third crisis of the relevance of its curriculum. The problem of relevant curricula comes under two headings. First is the relevance of general subject matter: that is, a better balance of humanities, social sciences, and sciences that most universities have provided or are even now prepared to provide. A second problem is the applicability of the education received. An educational system may offer a balanced diet of the three large disciplinary areas but still all of them at such an abstract level that students would find their needs not met.

So in addition to a balanced curriculum among the three great fields of knowledge, universities are also under pressure to provide a balance between basic and applied studies. Obviously the newer the country the more pressing are the demands for applicable knowledge, while for the mature countries a more balanced diet between basic and applied work is desirable.

But the problem of applied versus basic, or relevant versus traditional studies in the newer countries is not an easy one to resolve. Applied studies do not flourish very long unless they are attached, in fairly close proximity, to more abstract matters. Most scholars realize that to do this they must have connexions with scholars in more mature countries.

There is, in this arrangement, a great danger of a brand of intellectual colonialism which will keep the newer universities from ever rising to the same level of sophistication and influence as those in established countries with which they have developed connexions.

Finally, universities in developing countries need such contacts almost more than established universities, but if they are to tilt their interest too heavily toward the applied sciences they will cut themselves off from some of the most vigorous intellectual growth going on in other parts of the world. The pressure for attention to applied work remains and will probably have to dominate the academic scene in developing countries, but not at the complete expense of attention to traditional matters.

One other point needs to be made about the matter of relevance. As the numbers of students have increased, larger and wider cross sections of our societies have been admitted to the universities and many of today's students are first-generation entrants without any family tradition to prepare them for the rigour of their studies.

In addition, many are from minority groups or heretofore deprived groups of their societies, and the immediate utility of their university experience has to be demonstrated not only to them but to the families who can ill spare them. The result has been an insistence on the part of these new classes of students at the university that there be a direct and visible demonstration that what they were being taught had a direct connexion with the agonies of the environments from which they came.

In the United States this has been most vividly witnessed by the demands of many Black students for courses that would help them improve the city ghettos from which many had come. In Latin America, the Indian from Bolivia, Colombia and Peru was demanding an education that would help rescue him and his family from the grinding poverty of his culture. In less harsh tones, perhaps, this case is being stated with greater and greater emphasis by students coming from the industrial cities of England as well as the southern parts of Italy.

Even a casual observer will see the connexion between numbers, costs and relevance. To provide education that is relevant to a variety of demands is a costly business, while higher costs require demonstrably higher relevance. And as the university meets these demands for relevance and offers differentiated programmes, one can expect an increased interest in university attendance, which will feed the cycle of numbers, costs, and relevance.

This brings up one of the ironic features of the current scene, namely, that these crises are in large part the result of the university's successful adaptation to the needs of its various publics. As the university succeeds, its problems increase rather than decrease.

BUT even these three interrelated crises of costs, numbers and relevance do not, by themselves, determine the atmosphere in which the university is struggling to perform its mission today. By themselves they would have produced convulsions of major proportions and the problems of adjustment would have been severe. But there are deeper matters at work that have enormously complicated the business of university management—which brings us to **the fourth crisis: the crisis of the new priorities.**

Somewhere in the beginning of the Sixties, at least in the more developed countries, the leading edge of these societies shifted its social priorities away from attention to affluence, full employment, and peace-keeping by military power, and toward more preoccupation with justice for the minorities and the poor, the quality of the environment, and peace-keeping through the subordination of national ambitions to the idea of the international community. Not every country has felt this shift in priorities in either the same manner or the same degree. But that some glacial change began to take place during this past decade is hard to deny.

One feature of this shift was the adoption of the new priorities by the

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young, while the adult world, with vivid recollection of the Depression and the two world wars, was not about to abandon its deep concern for a rising GNP and world peace by military means if necessary.

Much has been made of the generation gap, and while there has always been such a gap, something new has been added. As societies modernize, the individual becomes free of both restraints and duties imposed by tribe and family. Modern society requires mobility and encourages it. The young are sent to school while the adults are drawn into the whirlpool of professional life. Thus the young are left to create their own culture and their own societies.

This disjunction of the generations would have produced a whole variety of complicated social problems even if the pressing concerns for justice and peace had not been adopted by this new generation. But independence fuelled by zeal, alienation fed by distrust, separatism exaggerated by fundamental difference in philosophy —all have served to present the universities with problems that are not just complex, but explosive. They are explosive because the generations coming to the university saw their dissatisfactions, caused by numbers, costs and relevance, through the red glare of anger at the society of which the university was an increasingly important part.

In these circumstances it was inevitable that the university—while trying to deal with its internal priorities — would find the new social concerns of its students almost impossible to resolve. They might be resolved if the students were content to have the university function as a neutral forum in which these serious external problems could be debated.

But having become so closely identified with the society that supported it, the university, clearly, was not only an instrument for investigation, but a target for opposition. This fourth crisis of the university stems from a schizophrenia not yet resolved—namely, whether the university is more valuable as a neutral arena for inquiry and debate, or more valuable as a lever for social reform.

In general, when societies are divided, universities have had difficulty in establishing their neutrality, or at least maintaining it, whereas when a society has a substantial consensus on its main priorities, university neutrality becomes the more possible.

It is not surprising, therefore, that the countries that have had the most difficulty with their universities have been those with the deepest divisions in their social philosophies and social programmes. Universities are struggling today with this enormously complex problem, which has become a heavily political issue.

Most systems are trying to plot a course between the two extremes of neutrality and social activism by maintaining the maximum of independence from society while also making concessions to the new concerns in admissions policy and curricular ventures. Numbers, costs, and relevance are terribly important issues, but the central question is, to reiterate, the role and mission of the university: Is it a neutral and protected arena for free thought, or an instrument for social betterment? The division of opinion on this question has produced a crisis that has inflamed the others.

Behind even the crisis of university identity and mission there is another and deeper crisis that imperils the very idea of the university itself. **This fifth crisis is the new scepticism that denies the possibility of objective, rational thought.** It would take a whole book by itself to thread our way through the complexities of this century and to trace the widening attack on the rationality of man and even on his potential for rationality.

Suffice it to say that the comfortable Western belief that reasoning man in a reasonable universe would increasingly comprehend his environment to the benefit of a better evolution of mankind is a notion that has less currency with each passing year. In its place has risen a mysticism and a belief that somewhere in the dark reaches of the mind, in the senses and sensations, in feeling rather than in thought, one is more likely to find truth than in an objective examination of the world around us.

All this has undermined one of the central notions upon which the university is based—that learning is cumulative and that the opportunity for rational discourse is its raison d'être. With these concepts under attack, the

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STANDING ROOM ONLY. Student "cram-in" in this lecture hall at the Sorbonne, in Paris, illustrates one of the big problems of the modern university—the crisis of numbers. Enrolment in higher education has doubled on the average in the last ten years and is likely to double again by 1980. Throughout the world the largest percentage increase in educational growth is at the level of higher education.

Photo © Paul Almasy, Paris

idea of the university itself is in question.

In summary, therefore, the university is facing five crises—the crisis of numbers, the crisis of costs, the crisis of relevance, the crisis of priorities, and the crisis of scepticism.

Is it surprising therefore that the problem of university governance is both universal and pressing? Any institution that had such a series of interrelated crises placed on its agenda within a relatively few years would have staggered under the load. It is one of the miracles of the century that the university has survived at all.

A professor who comes on stage briefly as a distinguished president, rector, or vice-chancellor will not even understand the problems in a short tour of duty, let alone be able to handle them.

Recent convulsions on the campuses of the world have not made university management an attractive next step for the distinguished professor. Considerable tradition still protects the professor in his classroom and laboratory, but does not serve to protect the president or rector in his office.

Staffing, however, may turn out to be the least of the difficulties in university governance. The redistribution of power and responsibility between students, faculty and the administration is bound to preoccupy those driven by concern for relevance and for the new priorities.

Those who are caught up in the current social revolution are demanding the university's participation and are not likely to find the traditional roles of faculty, students and administration to be congenial to their objectives. It would be a great error to assume that the current redistribution of power rises merely out of the maturing of the entering student body. The real fuel for this demand for new style of governance comes from those who are dissatisfied with the curriculum and who believe that new forms of governance may be necessary to redirect the university onto different paths.

We have been inclined to think of the crisis of the university as being the crisis of governance. This may be so, but we will not understand the nature of the crisis of governance unless we realize it is compounded of five crises of numbers, costs, relevance, priorities and scepticism. No new organization chart will be adequate to embrace the considerations with which universities must now deal. Statesmanship of the highest order, both in and out of the universities, will be necessary if they are to fulfil their historic mission in our new world. ■

A WORLD APPROACH TO THE WATER CRISIS

(Continued from page 13)

general hydrological survey. The Chad Basin project, which got under way in 1966, is an outstanding example of practical, scientific co-operation.

Another example is the study of ground-water resources in the Northern Sahara, which will cover the area underlain by principal artesian aquifers in Algeria and the Saharan area of Tunisia. The study is in progress under the auspices of the governments of the two States, under an agreement with UNDP, with Unesco serving as executing agency.

Quite a different type of project is the establishment of a Centre for Hydraulics and Applied Hydrological Research at Ezeiza, Argentina. This also will be assisted by UNDP, with Unesco as executing agency. The overall purpose is to build up within the State facilities for advanced studies and research in water science and to apply the results to practical development projects.

An establishment with a similar purpose is the Institute for Hydrosciences and Water Resources Technology in Iran, established by the Government of Iran, assisted by UNDP, with Unesco as the executing agency.

A considerable number of similar and varied activities may be cited: co-ordinated planning of International Hydrological Decade activities by the council of the five Nordic countries; research on uses of saline water for irrigation in Tunisia; world-wide research on the uses of radio-nuclides in hydrology (led by the International Atomic Energy Agency); the interstate hydrometeorological study of Lake Victoria, administered by the World Meteorological Organization, which also directs the development of the Central American hydrometeorological network; development of a flood-warning system for the Mekong River Basin; establishment of a Natural Resources Institute in Iraq; and many other activities.

Decade activities have exposed the glaring inadequacy of information about water in many parts of the world and the depressingly retarded state of some aspects of hydrology, the only science that can translate raw data into water information that can guide action to conserve and use water.

Developing countries are anxious to see construction machinery in action on water-development projects. International organizations that provide project funds also want to see dirt fly. Planning studies have generally been heavily weighted toward engineering and economic feasibility and minimally toward hydrological or ecological aspects. Possible unwanted side effects have received little attention. Consequently, some projects have been over-designed, under-designed or wrongly designed.

Over-design entails excessive costs for construction. Under-design results in failure to achieve maximum use of resources. Wrong design can cause either or both results, and it may lead to projects failing.

Circumstances are now changing and scientific studies are being authorized and carried out in advance of crystallization of plans and beginning of construction. An example, already mentioned, is the organized international study of the La Plata River basin in South America, involving five nations and one of the world's great rivers. Advance studies can save many millions of dollars of construction cost and greatly improve the benefit/cost ratio of projects.

Developing countries have recognized the necessity for cultivating their own hydrological competence and establishing observation networks. During the Decade, various governments and universities, with the collaboration and assistance of Unesco, have established advance-level semester-length special courses in hydrology and water resources problems. Such courses have been established in Czechoslovakia, Hungary, Israel, Italy, Netherlands, Spain and Venezuela. These are for foreign nationals.

In addition, Unesco, WMO and FAO, in collaboration with other organizations and universities, have sponsored many seminar-type short courses in hydrology, chiefly in countries of Latin America and North Africa. Further, various universities in developed countries have offered many scholarship to foreign nationals to enable them to enrol in regular university curricula oriented toward hydrology.

The International Hydrological Decade has created a new awareness among the nations of the world that water problems are large and growing. Thus the Decade is taking its proper place among the many international programmes that aim to improve the lot of all men in all places. ■

XUM

MODERN ART AT UNESCO'S NEW BUILDING

Photos Unesco - Dominique Roger

Unesco has added a new building to its Paris headquarters. Located a short distance from the four existing H.Q. buildings in the Place de Fontenoy, it was inaugurated by the French President, M. Georges Pompidou on March 17 this year. Here we show three works by internationally known artists which decorate the building. Left, walking figure by Alberto Giacometti, a work in the highly individual style of the famous Swiss sculptor, stands in the main patio. Above, abstract sculpture in steel by Spanish artist, Eduardo Chillida, outlined against the façade of the building. Below, designed by Soto of Venezuela, two "op art" ensembles, incorporating coloured rods and a revolving element, stand in the entrance hall. Another modern work, a large mural by Ellsworth Kelly, of the United States, decorates the main lounge. Designed by the French architect Bernard Zehrfuss, Unesco's new eight-storey building also has two levels of offices set below ground level and opening on to four garden patios.

Photo © Johan Alexander, Paris

Letters to the Editor

ARMENIA'S ANCIENT PAST

Sir,

Last year marked the 2750th anniversary of the founding of Erevan, the capital of Soviet Armenia. This year it will be exactly nine centuries since Greater Armenia lost its independence (1070). However, those inhabitants who did not wish to submit to the Turanian hordes, founded in Cilicia the kingdom of Lesser Armenia, the last Christian state of the Orient, and ally of the Crusaders.

An Indo-European people of Traco-Phrygian origin, the Armenians are the heirs to a very old civilization. Armenia was the first Christian state in the world. Despite ravages of all kinds the country abounds in fortresses, churches and monasteries. This would make a fascinating subject for treatment in the "Unesco Courier".

Armand Mekitarian
St-Martin-d'Heres, France

MONGOLIA 1969

Sir,

I found your article on "Mongolia" (November 1969) interesting and, I am afraid, rather disturbingly naive.

Authors Facknitz and Kostikov state that the people of Mongolia were nomads because, since all the land was held by nobles and lamas, the nomads were reluctant to farm, and the revolutionary saviours finally opened up the land. However, since nomads generally like being nomadic, this argument is unconvincing. In Tibet, where a similar situation previously existed, those people who wished to farm had no difficulty in doing so and certain advantages existed if they did.

The authors' statement that "demands of the lamas were heavy burdens" is nonsense in the context of the religious philosophy of the people. Every family had at least one member who was a monk and thus had a vested interest in the monasteries. An assumed schism between Vajrayana Buddhism and the people is a typically non-Asian point of view and is taken only by those who have no understanding whatever of this religion itself.

The authors say that due to the sparse population there must be an increase in farm mechanization. Then, in all seriousness, they state, "the scarcity of people combined with rapid industrialization has created a problem which is probably unique in Asia : more people are needed to keep Mongolia's economic boom going." So now they have to increase the population to keep going the production which, in the first place, is supposed to be for the benefit of the population. Is it possible that, if production is not suited to the existing population density, something is wrong with the production method? This game of "ring-around" gives rise to a very serious question: which is of first importance, the sense of satisfaction and well-being of the people, or the game called "increasing the gross national product?"

The authors extol the virtues of rapidly-growing Ulan Bator and its "rival" (is there a race?) Darkhan. They measure the well-being of the people in terms of the number of theatres, prefabricated buildings and jazz concerts (which means that the people of London and New York are the happiest in the world!)

Why do we continue to insist that if only everyone would be like us they would be better off . . . oblivious to the fact that in "being like us" we have poisoned our environment, alienated our youth and brought mankind to the brink of annihilation.

Dr. D.K. Edwards
Victoria, B.C., Canada

PIONEER OF SOCIAL JUSTICE

Sir,

After reading your number on the International Labour Organization (July 1969), I would like to remind you that something had already been done to improve working conditions before the ILO was founded in 1919. One of the pioneers in this field was Daniel Le Grand, an early 19th-century French industrialist, who has been honoured by the ILO with a commemorative plaque at the International Labour Office in Geneva. I feel that his efforts to promote social justice should have been mentioned, even though the results were not apparent until later.

Pastor Stabenbordt
La Broque, Schirmeck, France

Daniel Le Grand (1783-1859) was the owner of a silk factory at Ban de la Roche, in Alsace. In 1841 he played a leading part in drawing up a law governing the employment of children in France. In 1811, the English industrialist Robert Owen had reported on the working conditions endured by children in mines. Daniel Le Grand followed up Owen's ideas and in 1818 called on statesmen attending the Congress of Aix-la-Chapelle to introduce in every country "measures to protect workmen against the ignorance and exploitation of which they are victims." Between 1844 and 1859, Daniel Le Grand drew up drafts of four international laws aimed at improving working conditions. Other French pioneers of social improvements include Louis Blanc, Pierre Leroux, Auguste Blanqui, Constantin Pecquer and Dr. Louis Villermé, author of the disturbing survey on "the physical and moral state of workers in cotton, wool and silk factories" (1840). Another pioneer of social reform was Chancellor Bismarck in Germany. Between 1883 and 1887 he introduced laws providing for social security, limiting woman and child labour and establishing maximum working hours—Editor.

NEW GLOBAL HORIZONS

Sir,

In "The Student of Tomorrow—a New Global Horizon" (January 1970), René Habachi's comments on our global upheaval, and changing attitudes and requirements, are almost a reflection of the Baha'i writings, which date back to the last century.

These writings insist on everyone having an adequate education, freed from rote learning, in order that man can learn truth for himself. They also espouse many of the concepts on which the U.N. and its agencies are now founded, and many which have yet to be implemented if we are to solve our global dilemmas. These include the acceptance of the World Court, a global currency, a world police force, an international executive body, a single working language etc.

Perhaps your excellent journal could inform us further on these concepts.

R. W. Fowler
North Bay
Ont. Canada

WHY I READ THE 'UNESCO COURIER'

Sir,

I am attracted to the "Unesco Courier" primarily because I believe in the fundamental need for international co-operation, having supported first the League of Nations and its successor the United Nations.....despite its present mood of discord and despair.

My second reason is that I think the magazine is itself worthy of support. It is pleasant to hold and read, with its excellent paper, print and quality of illustration. Your colour work is magnificent and the clever use of the scientific photographs of the "Sculpture of Vibrations" issue in December 1969 (I have not forgotten the meaning of the "S" in your title), is worthy of comment.

Similarly I have admired the excellent reproductions of paintings and sculpture: I can recall the African masks, your issues on Venice and Florence, and the Far East. These issues alone would justify my subscription, and I trust you will continue these.

I think you should concentrate on issues of international interest: I remember articles dealing with pollution (air, water, environment). You should attack evils such as deliberate and careless oil pollution from tankers at sea and refineries and carriers on shore, for these are not local troubles; supersonic airplanes, for the nuisance of the sonic boom troubles the many for the selfish advantage of the few (what DO they do with the time they save?).

Can we have a dispassionate assessment of agricultural herbicides: whether it is better for the world to suffer food shortages by their non-use; whether the abolition of malaria in Sicily by the use of DDT is balanced by the wiping out of certain rare birds by the concentration of DDT in their eggs.

I like stories covering examples of international co-operation: the Mekong Delta scheme, the India-Pakistan water control schemes, the Aswan Dam and removal of the Abu Simbel temples. Many of these, as well as other subjects mentioned above, I know you have covered.

I am not attempting to write your journal for you; merely expressing my views on the type of article I like and will read.

S.J.W. Pleeth
Haifa, Israel

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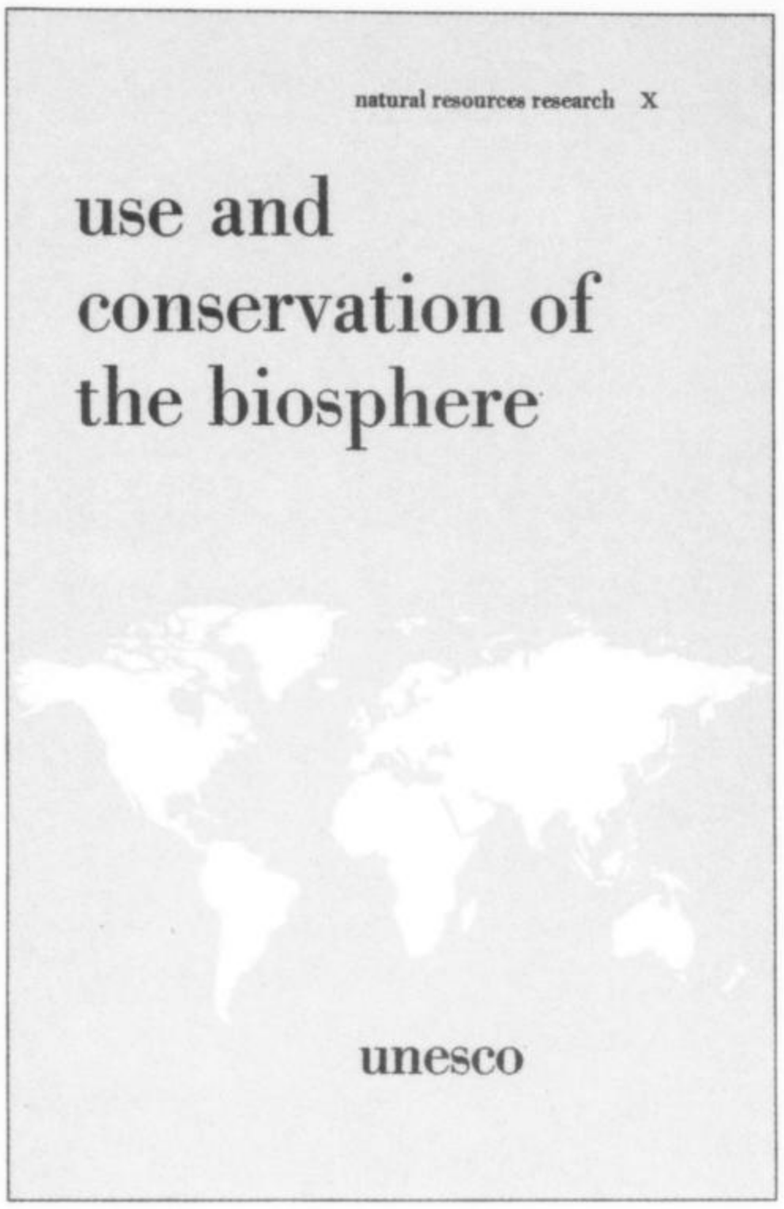

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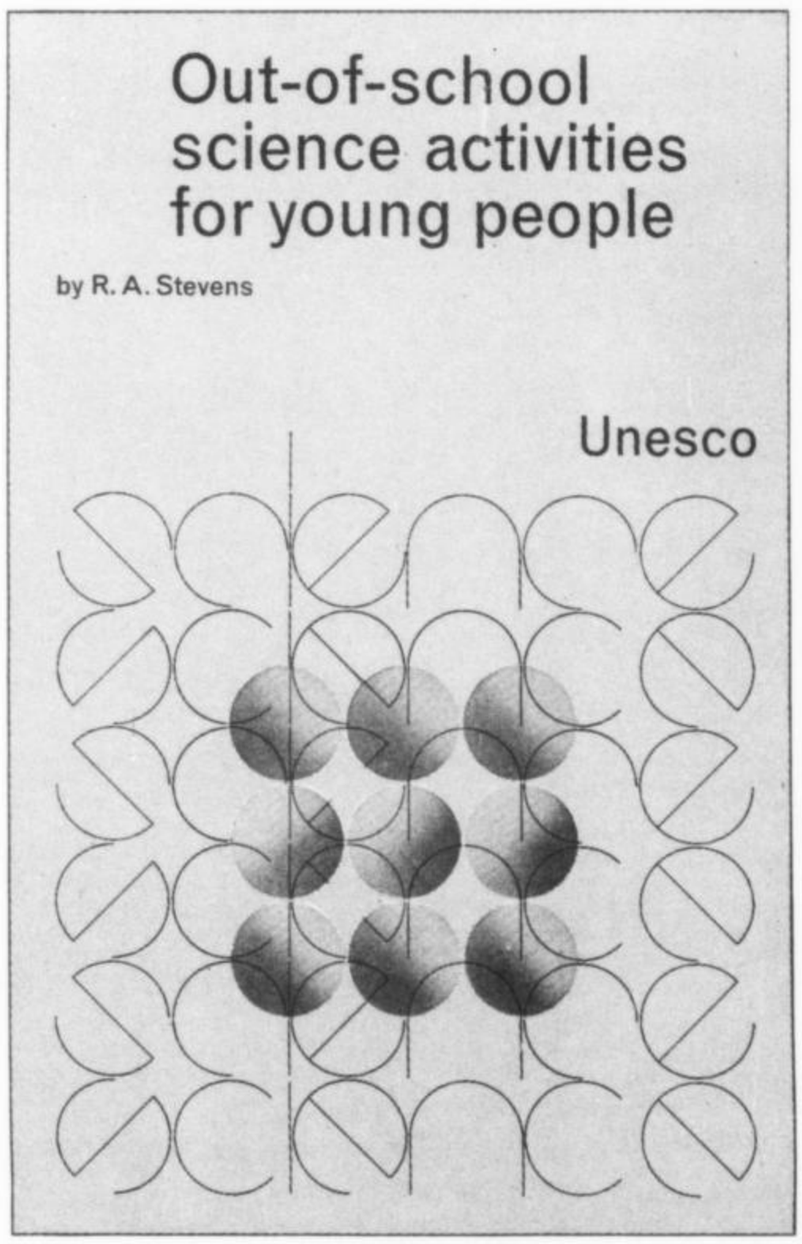

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ORIGINALITY AND TRADITION IN AMERICAN CULTURE

(See article page 16)

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